Are You Ready for an SIS?

What to do before starting on your SIS…and after it's installed

March 24, 2009

BLUEFIELD
PROCESS SAFETY

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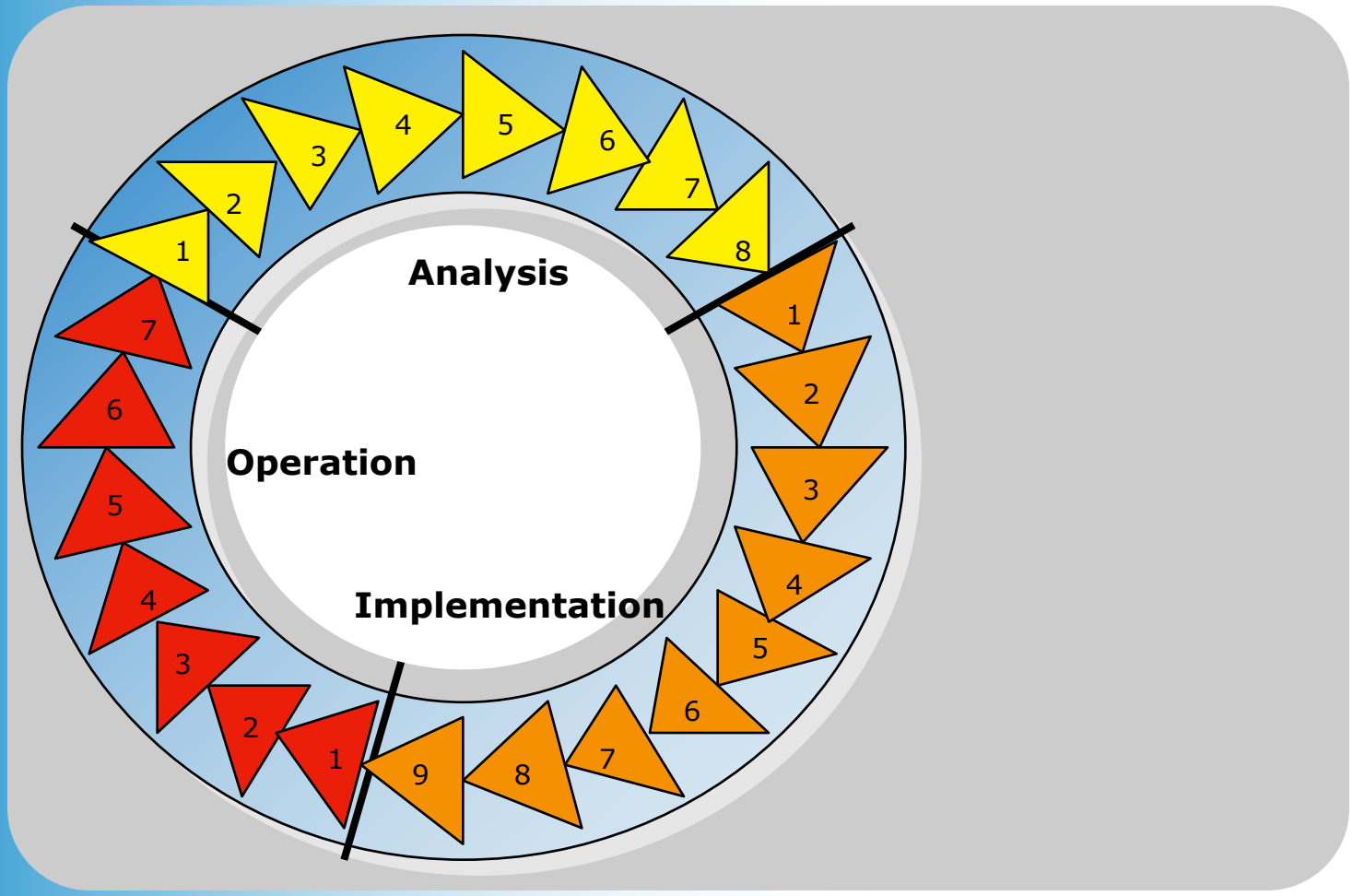
- Principal
  Bluefield Process Safety
- Principal Safety Consultant
  Emerson Process Management

Before starting on an SIS

- Steps of the Safety Life Cycle and Why They Matter
- SIFs and SIL Assignment
- The SRS
- After the SIS is installed
  - a conversation

The Safety Life Cycle



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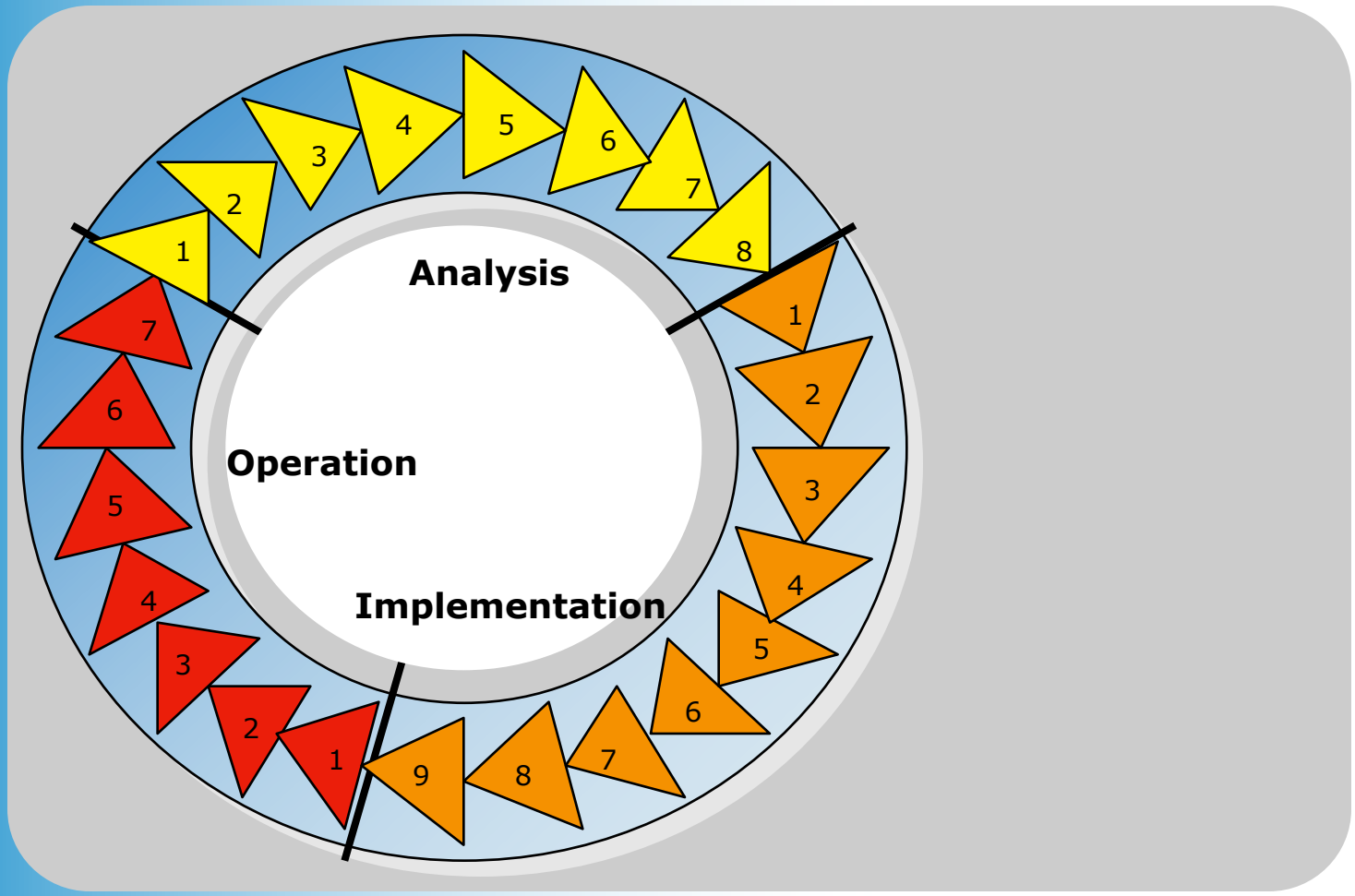

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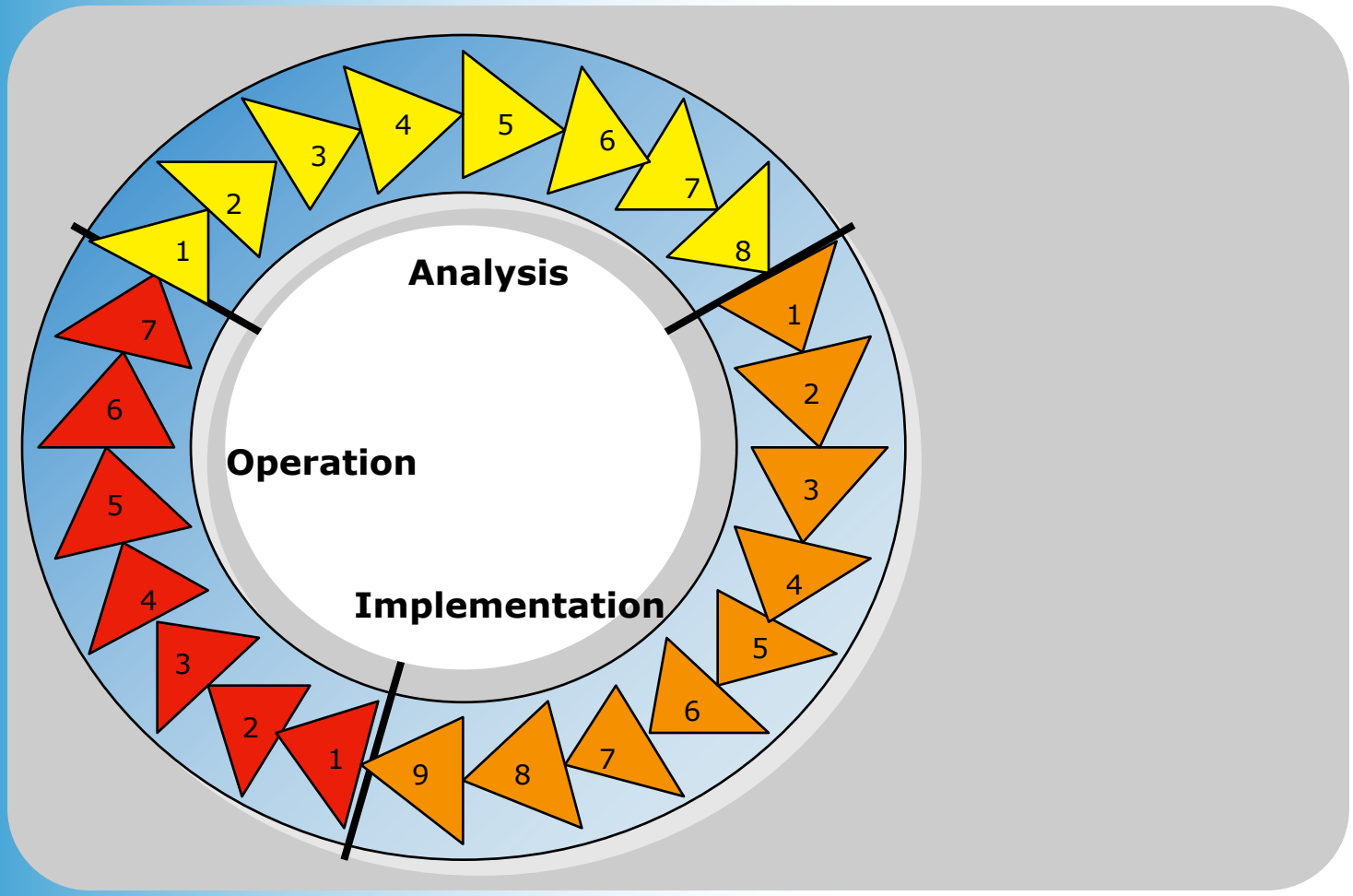

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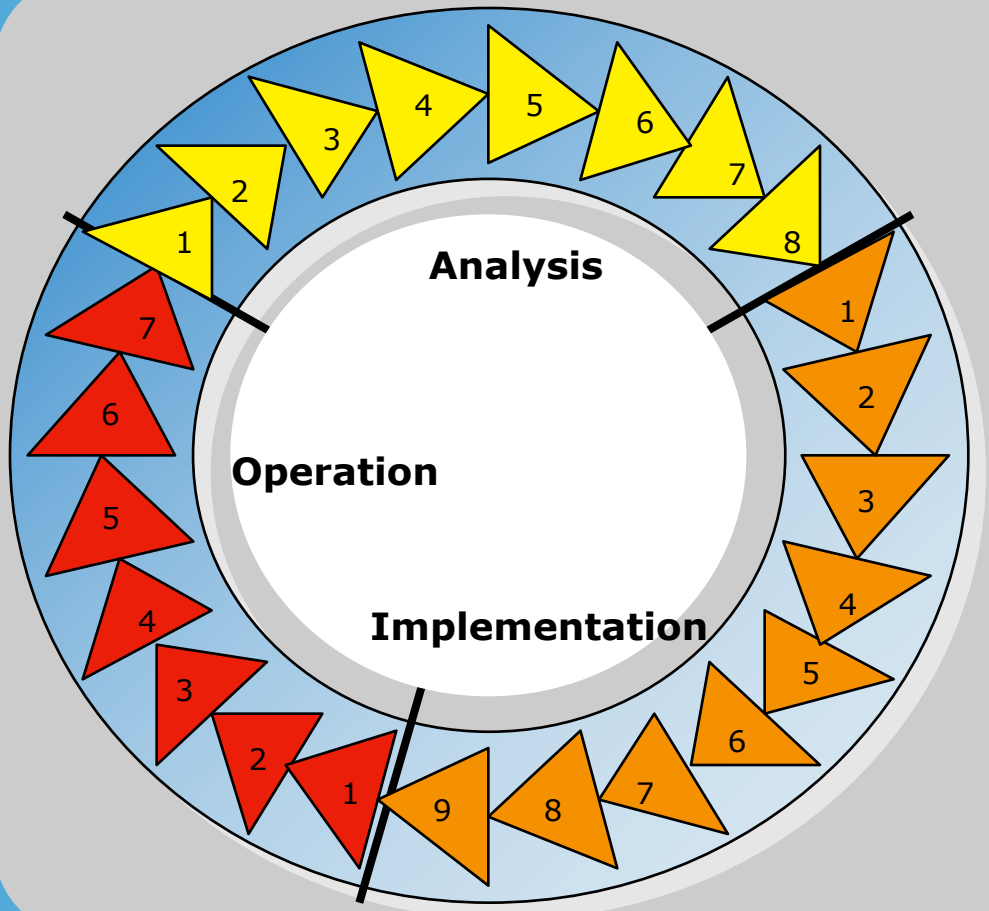

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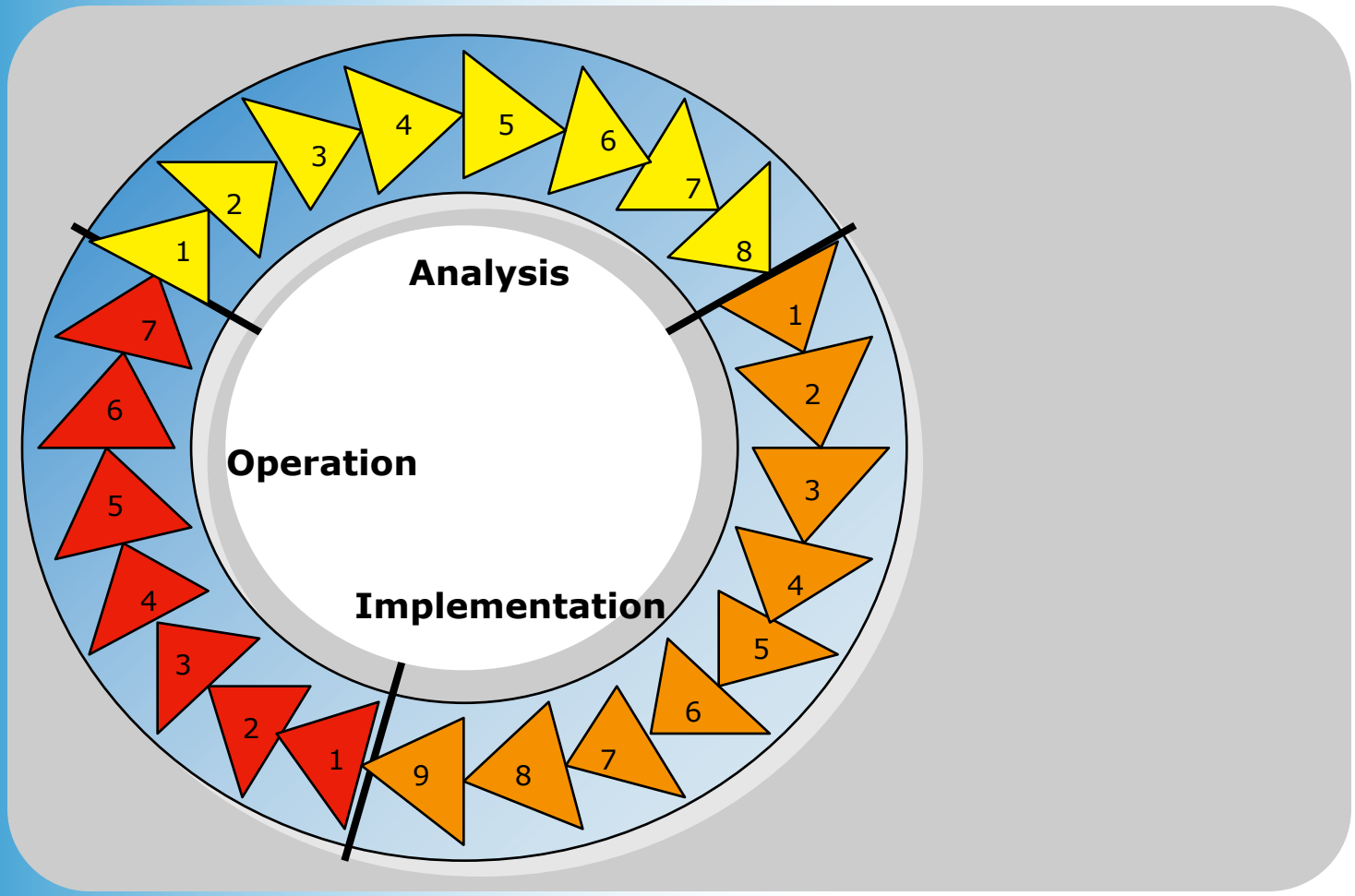

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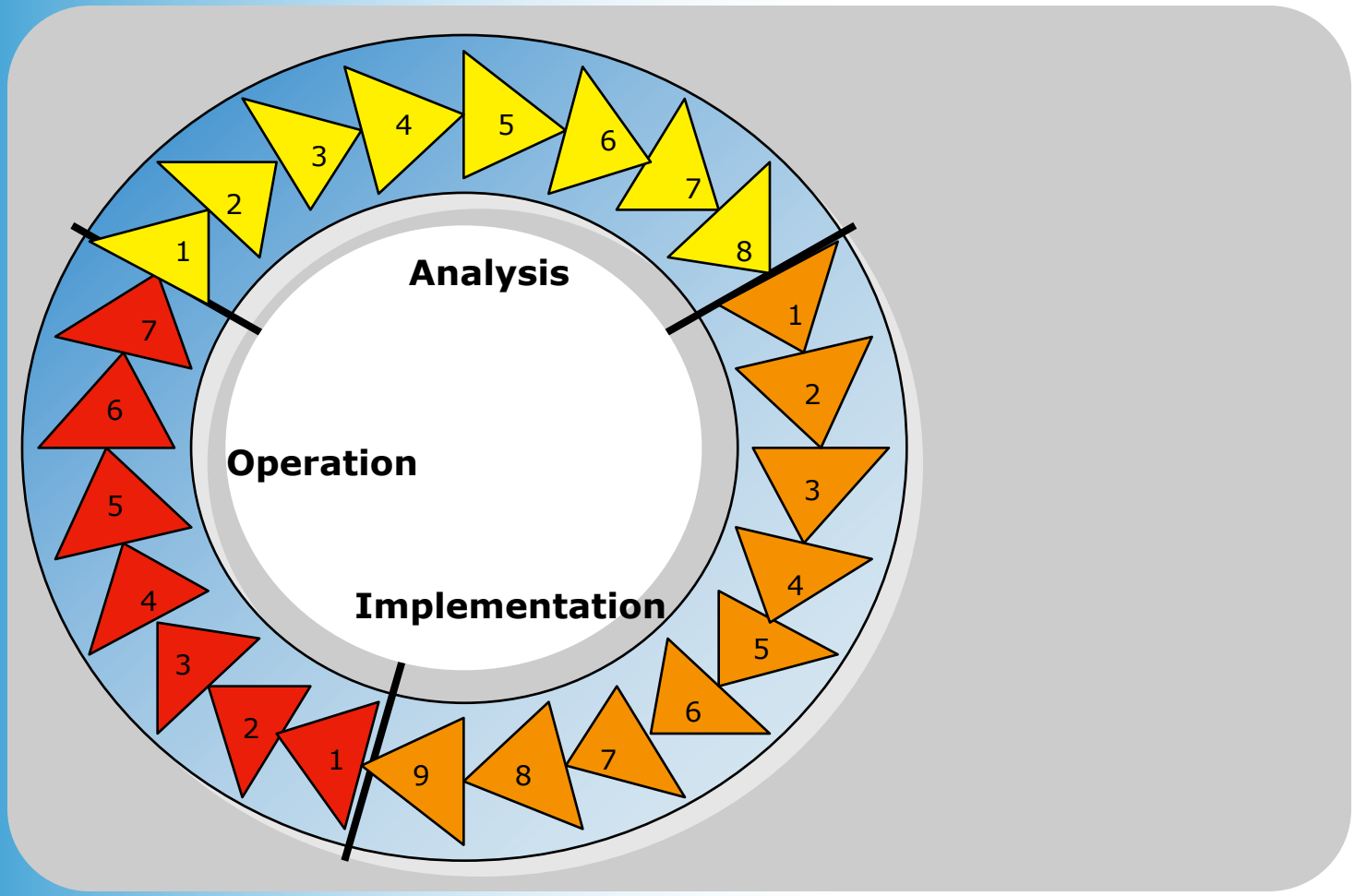

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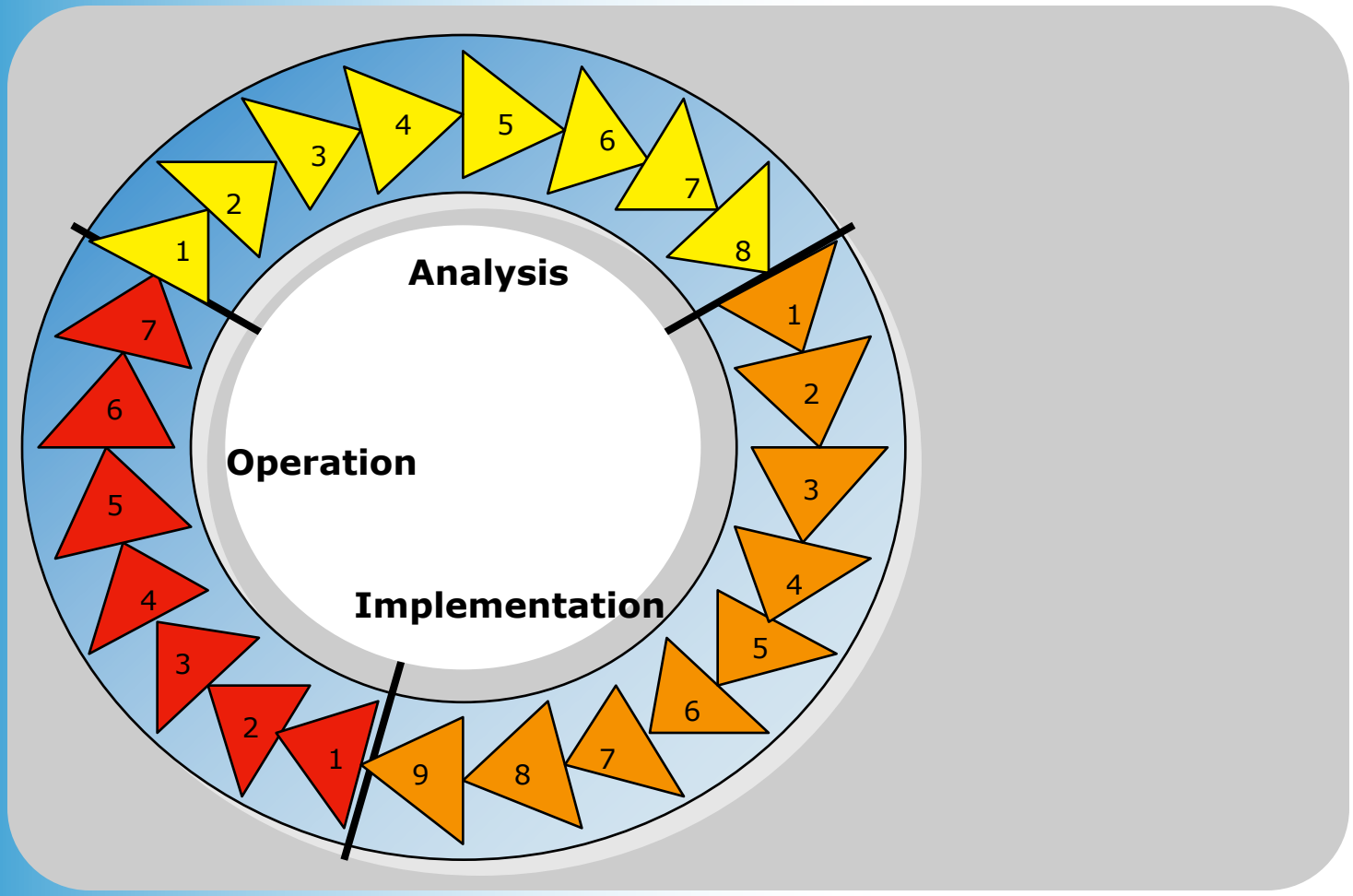

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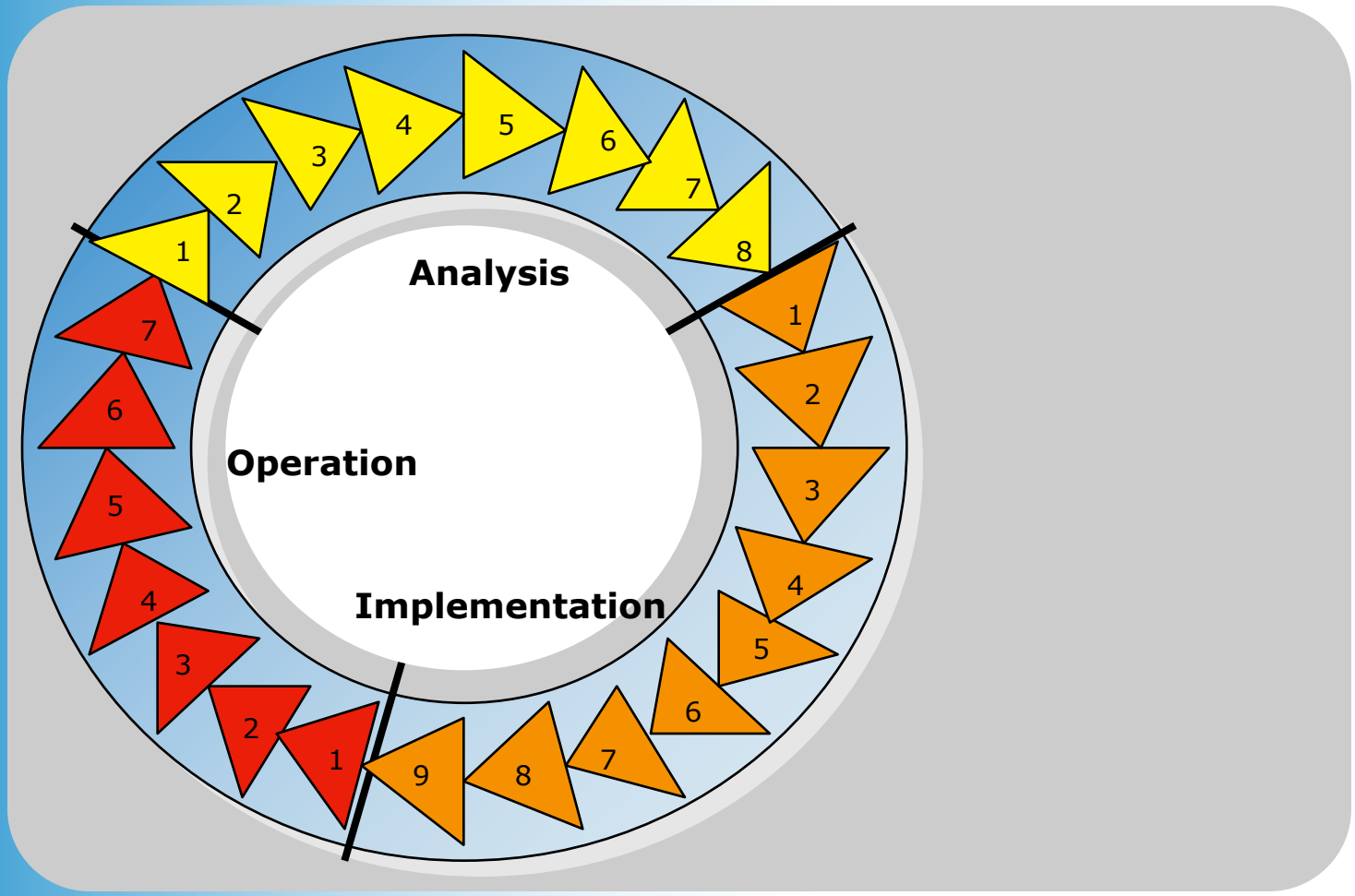

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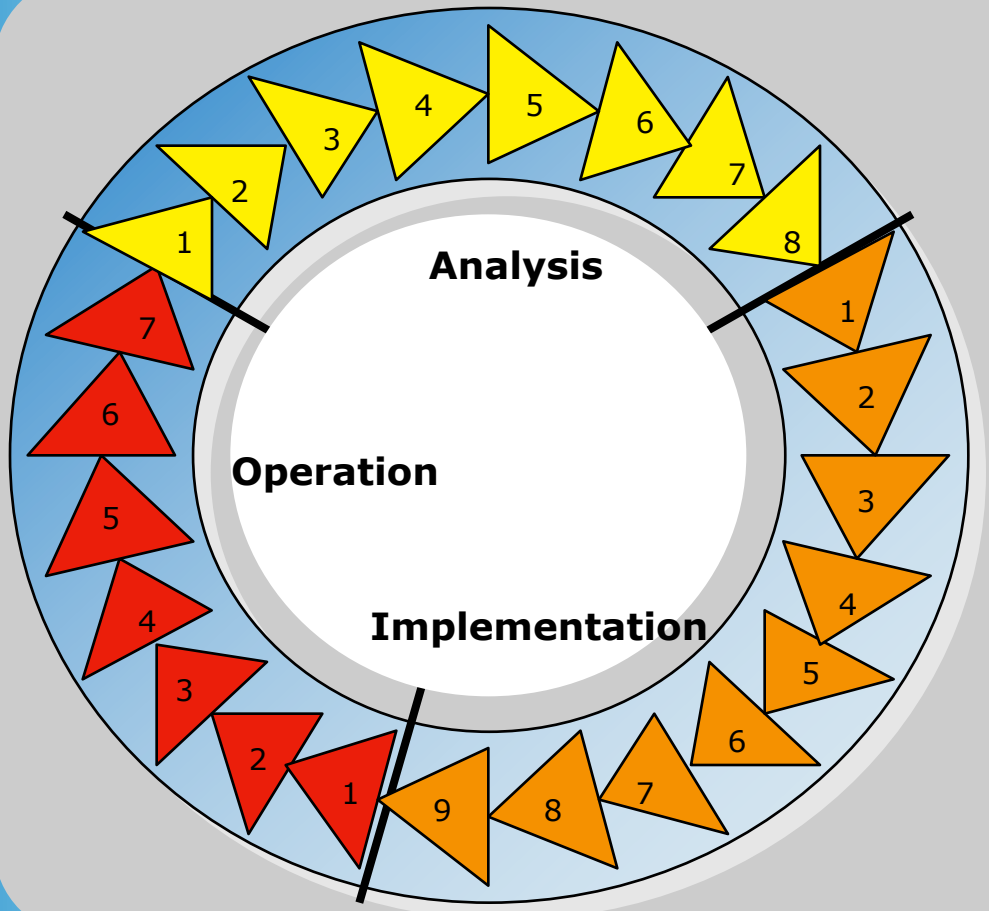

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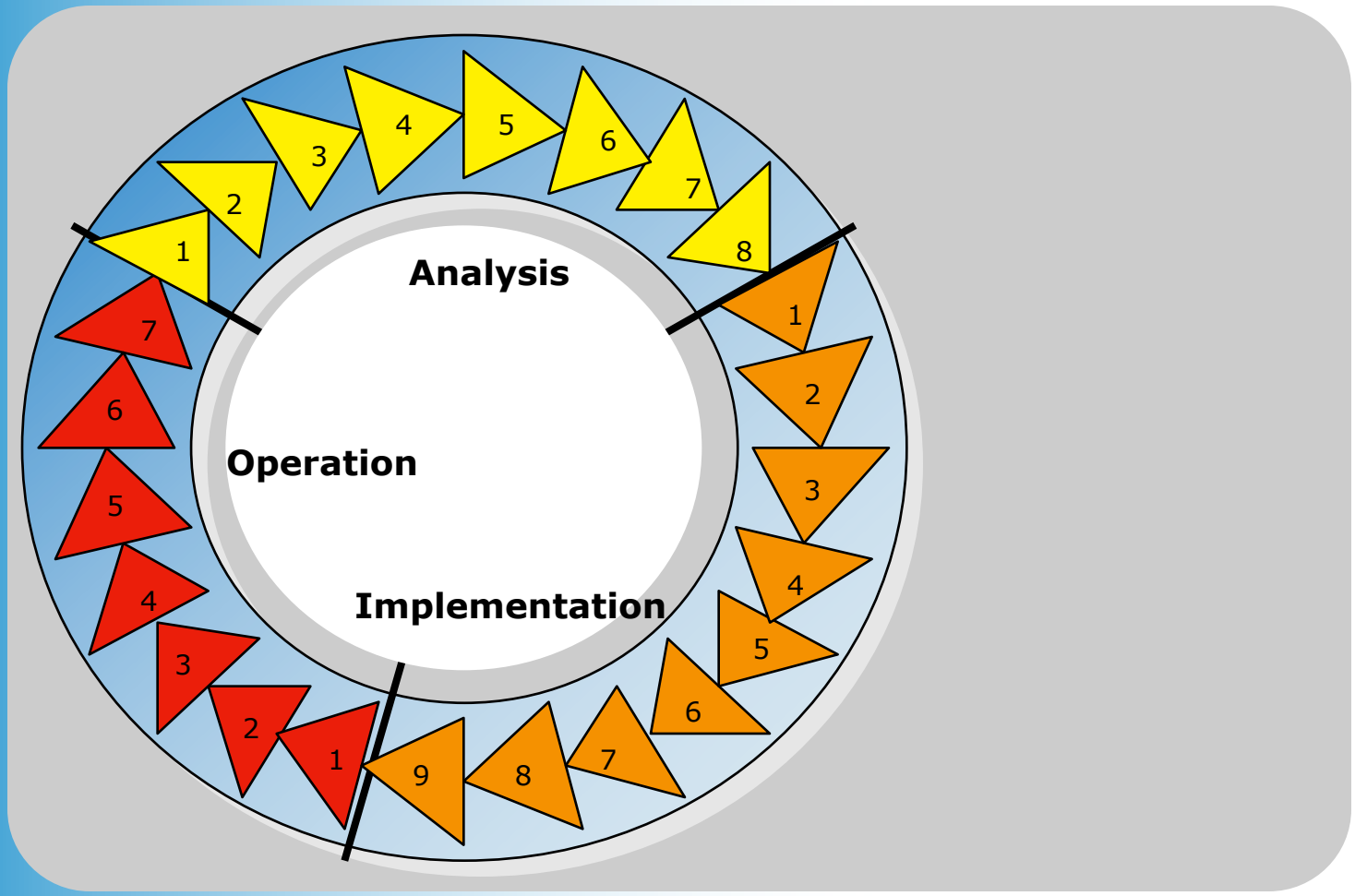

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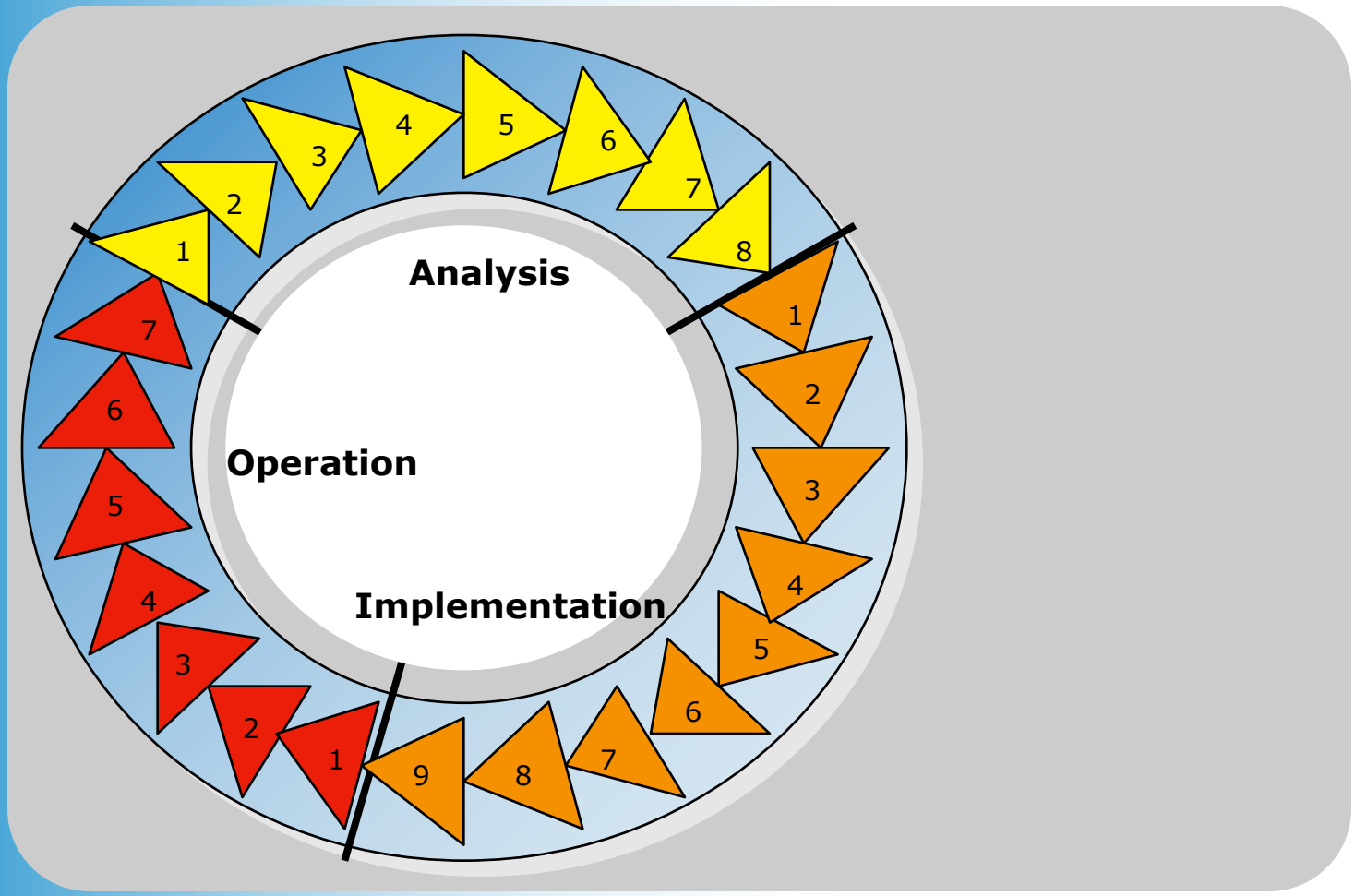

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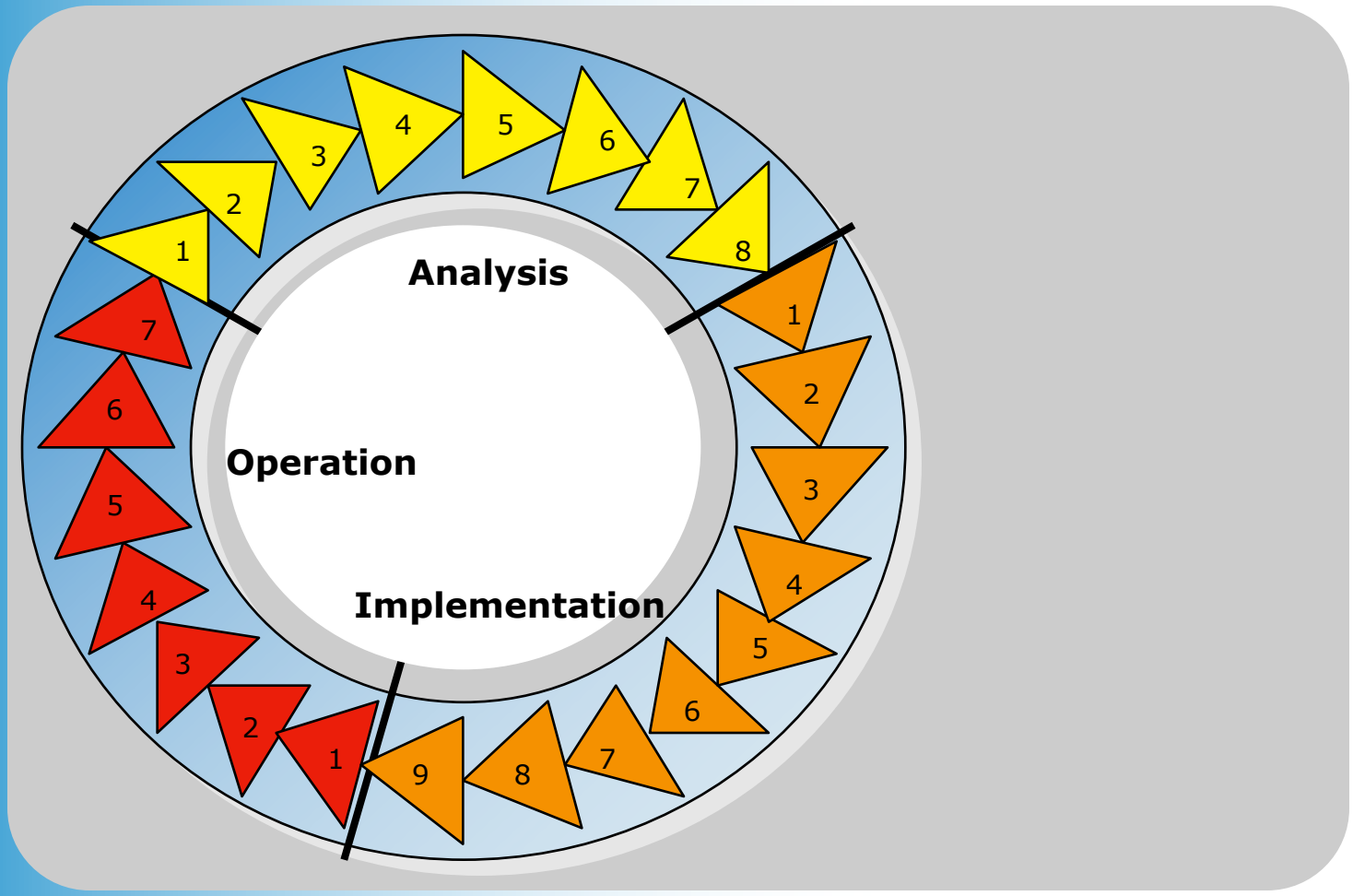

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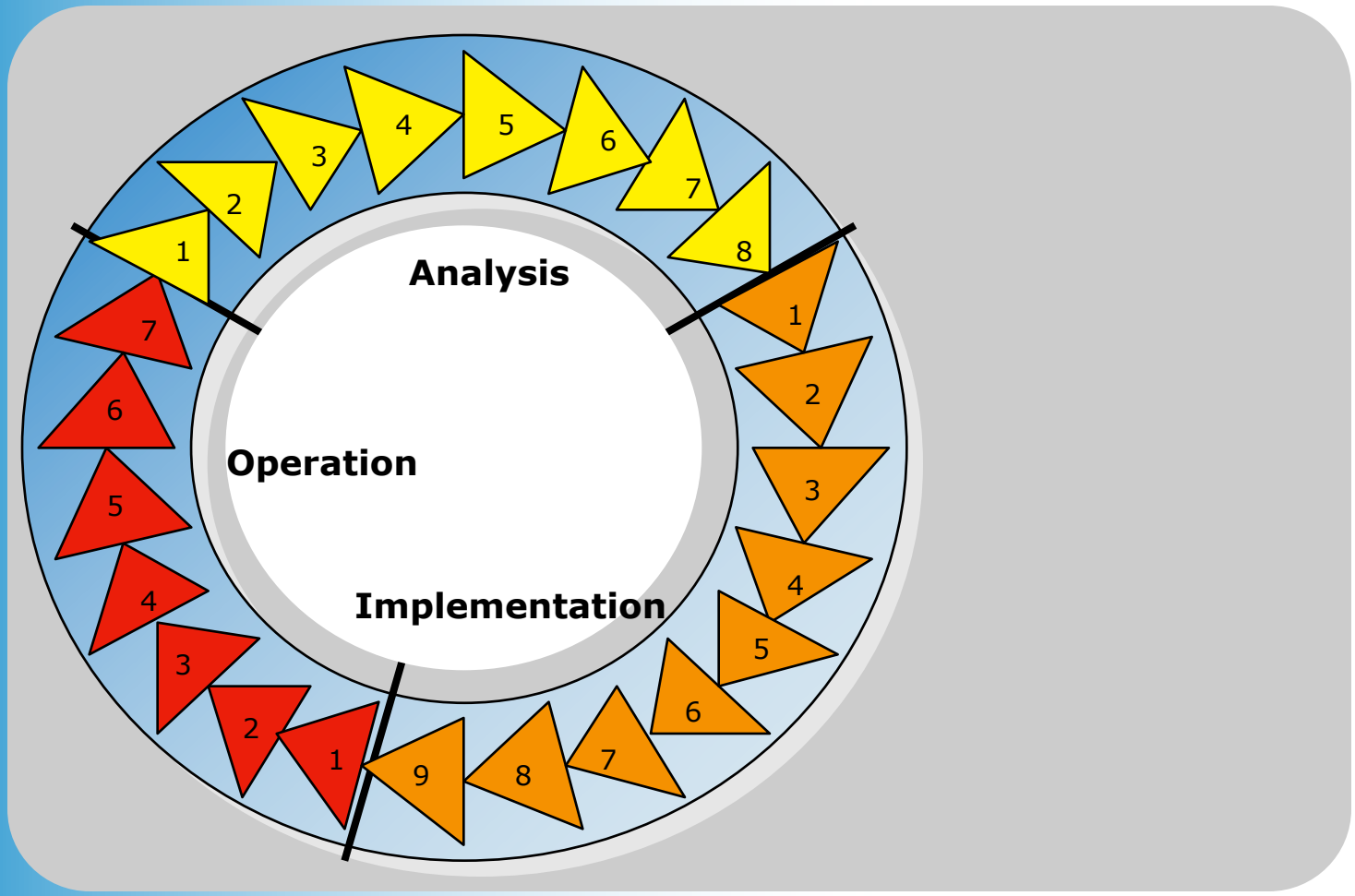

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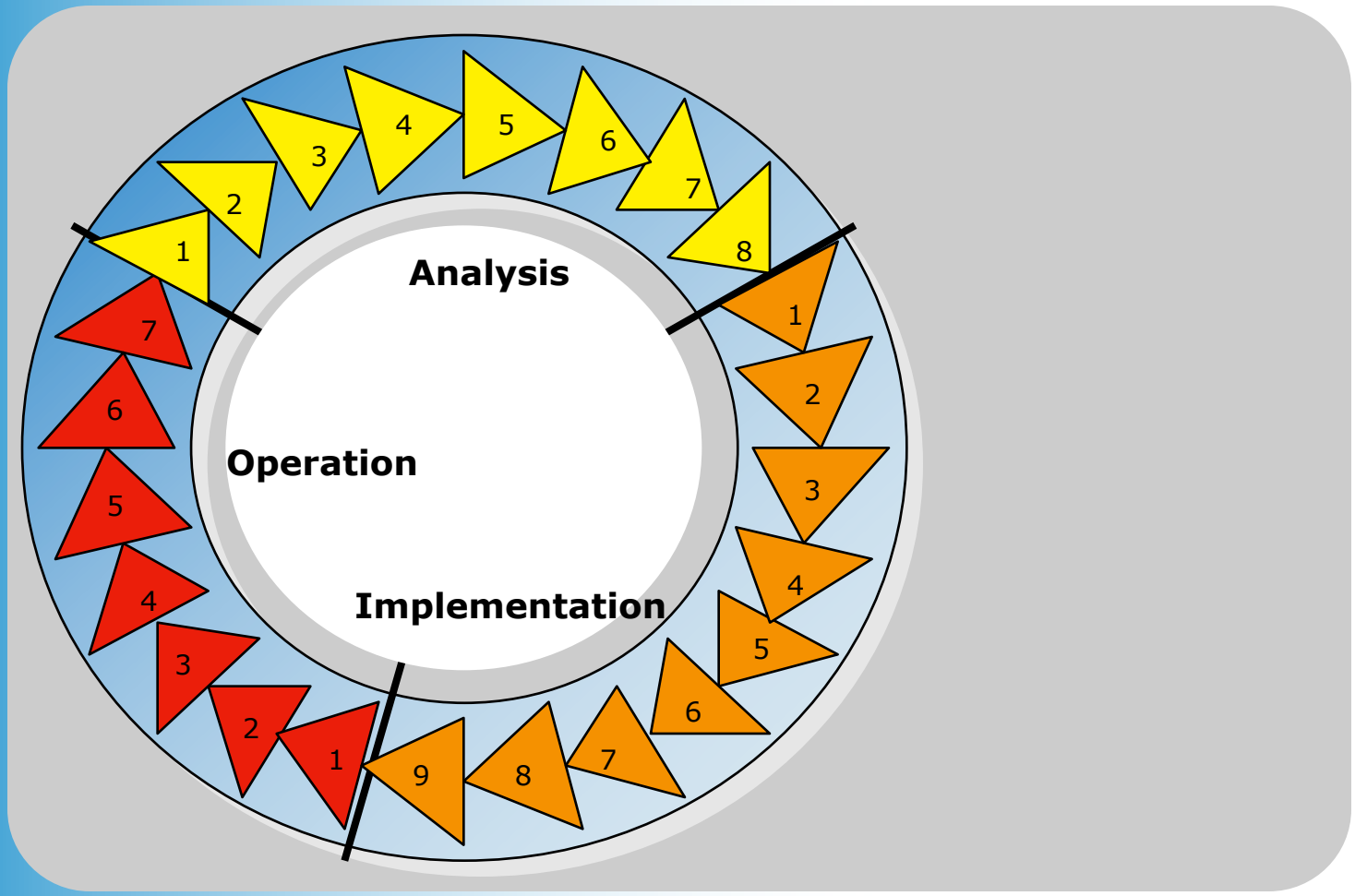

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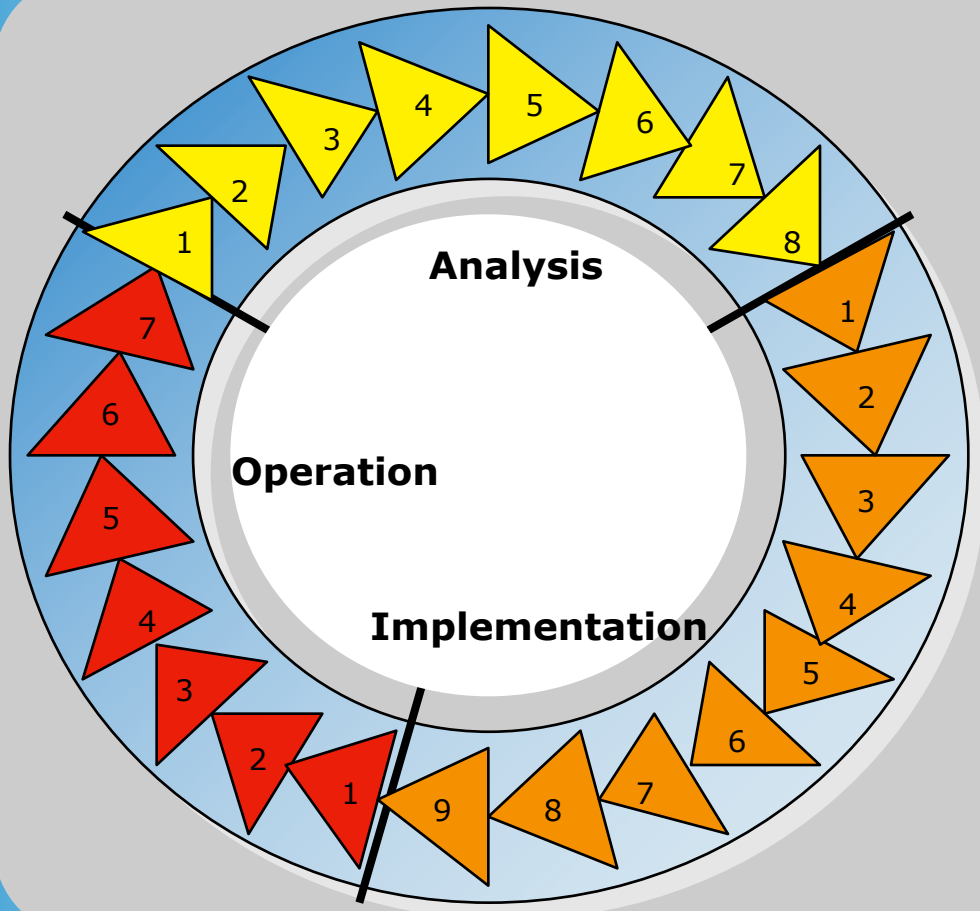

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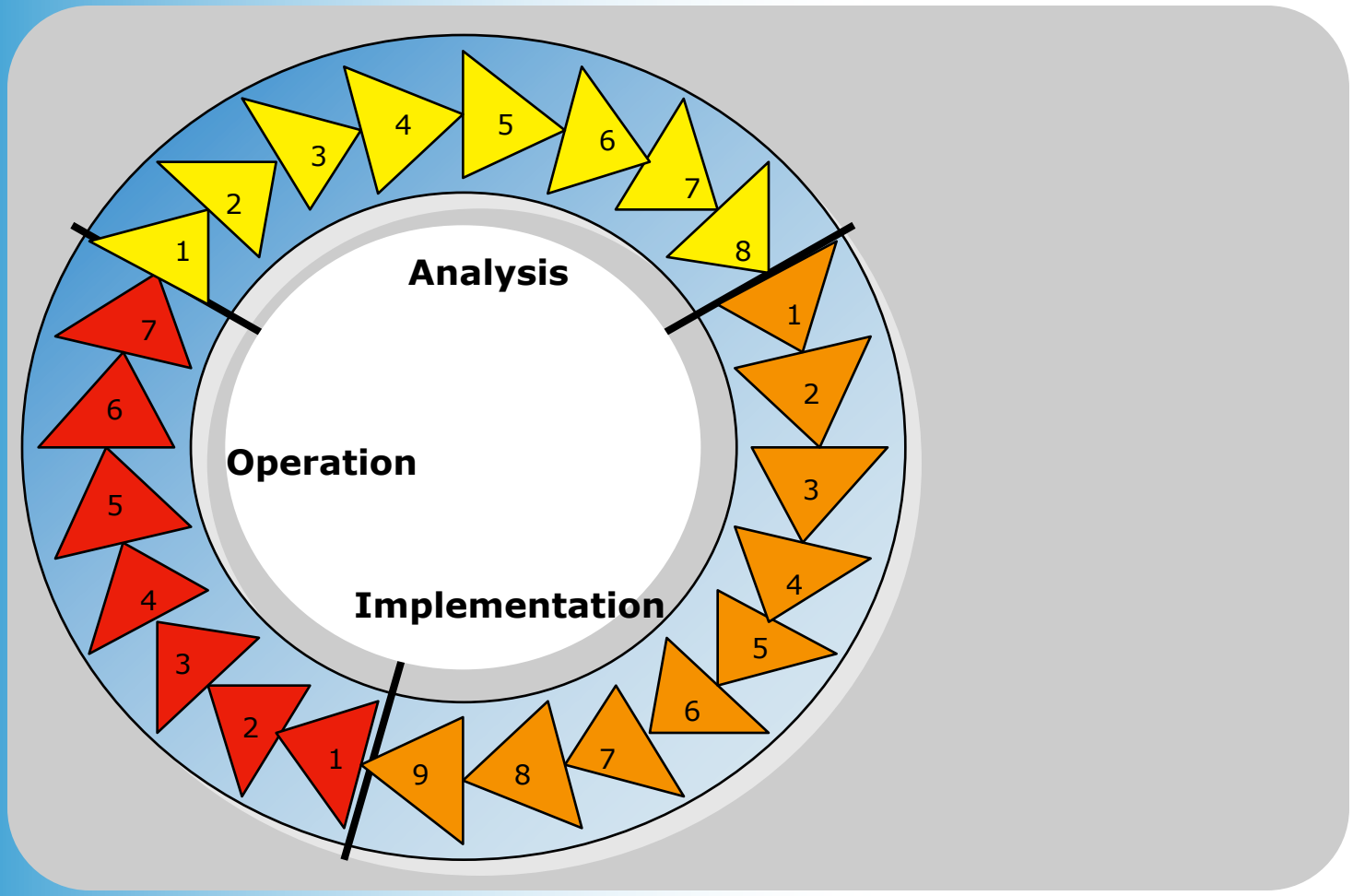

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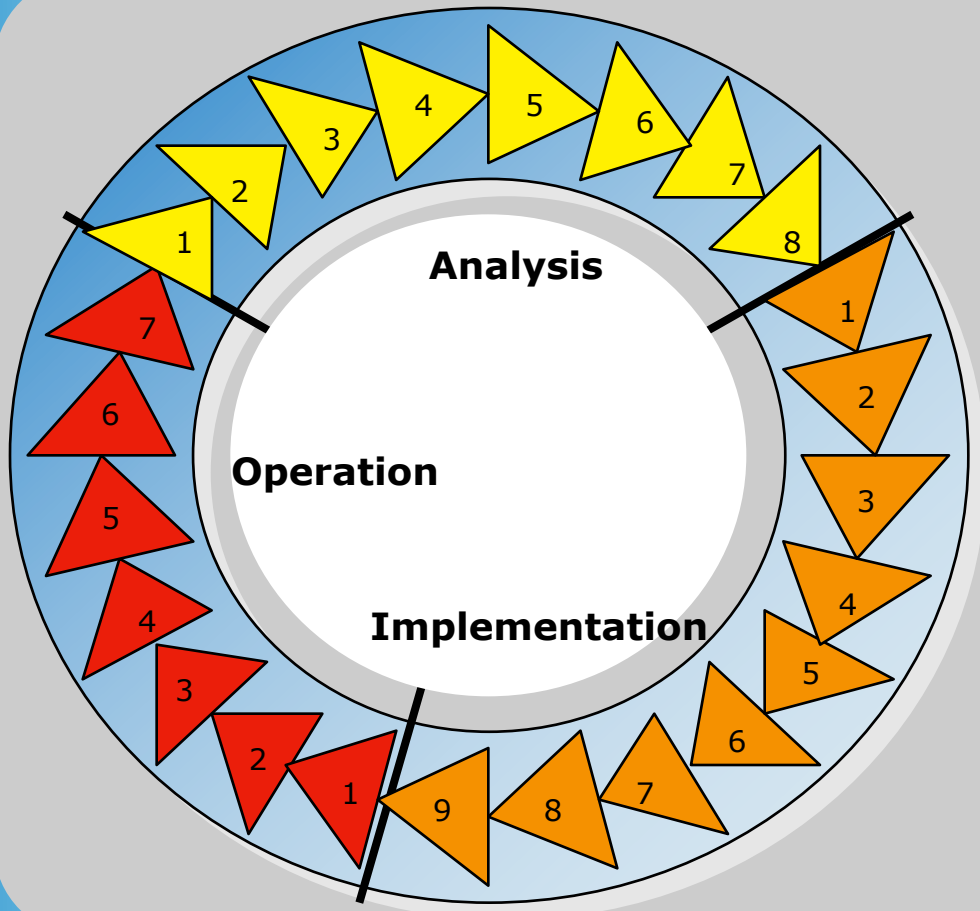

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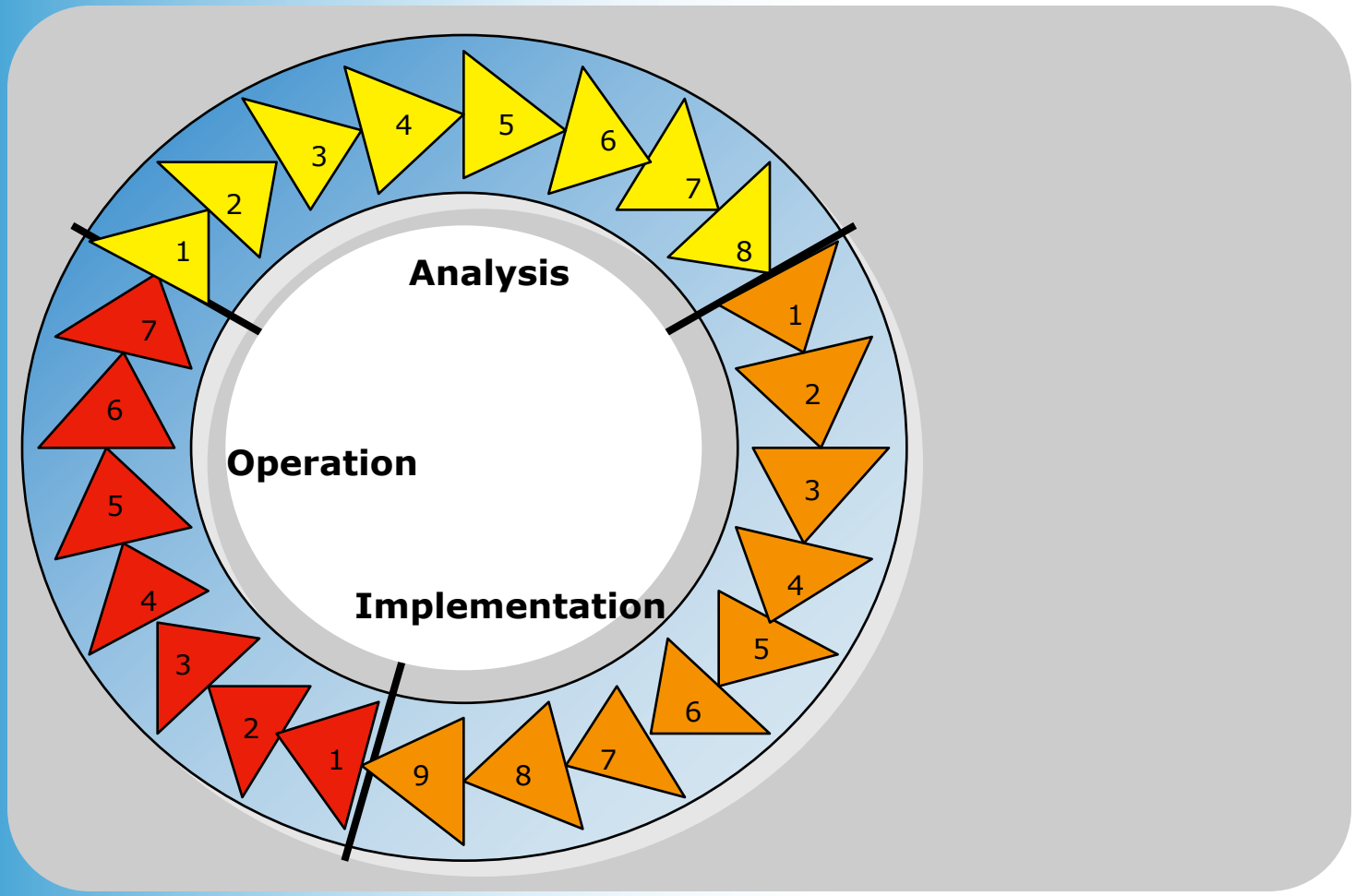

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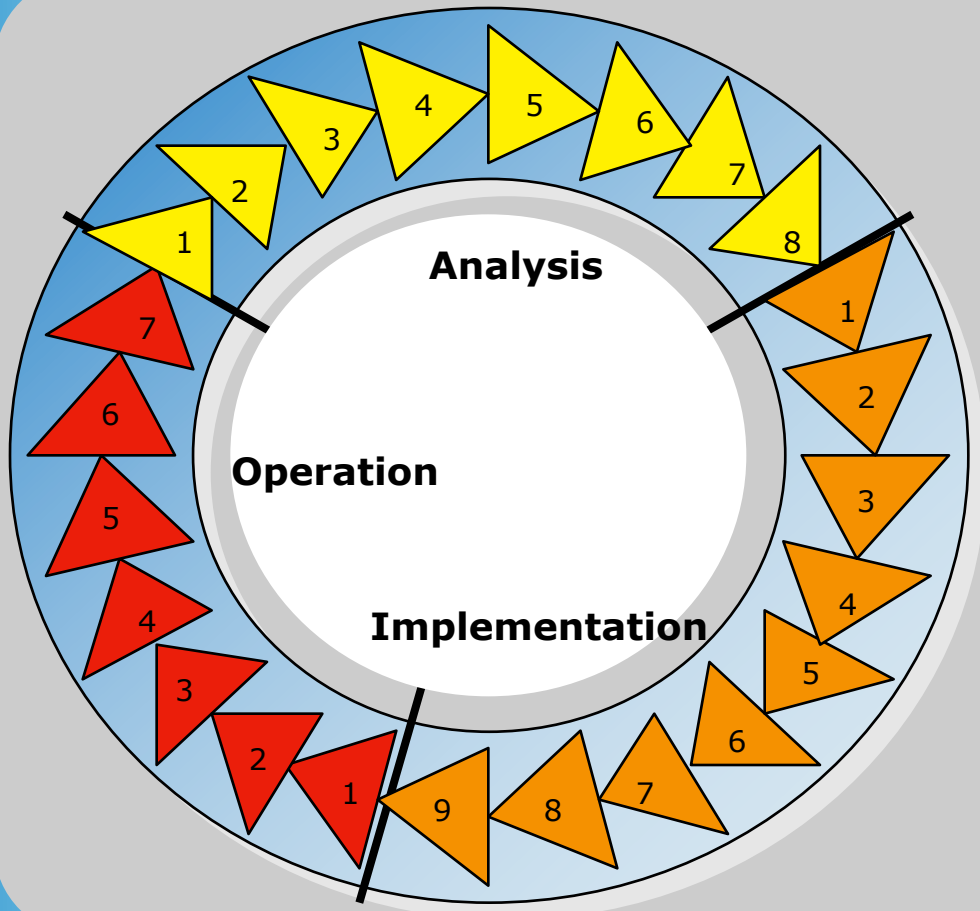

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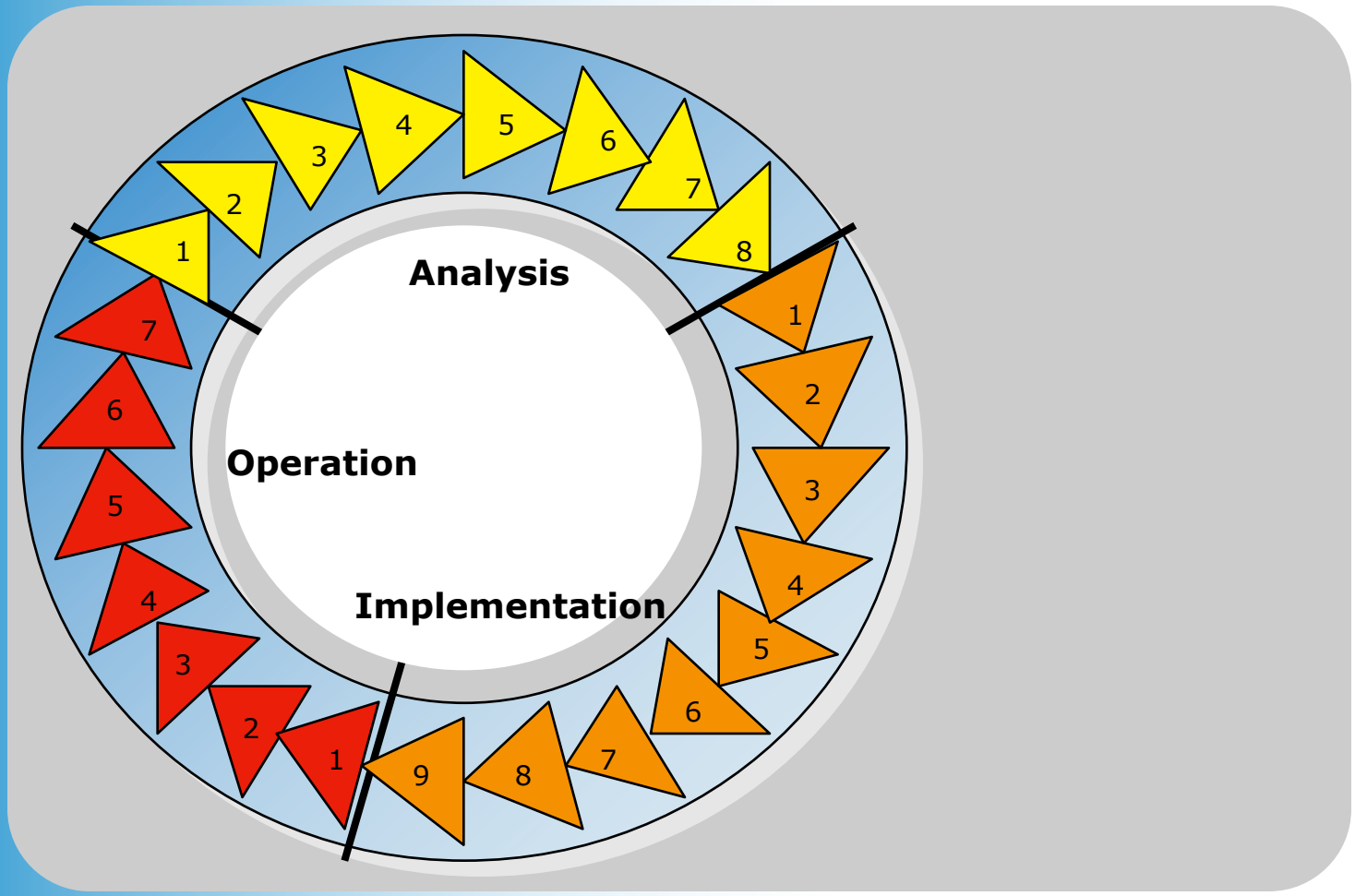

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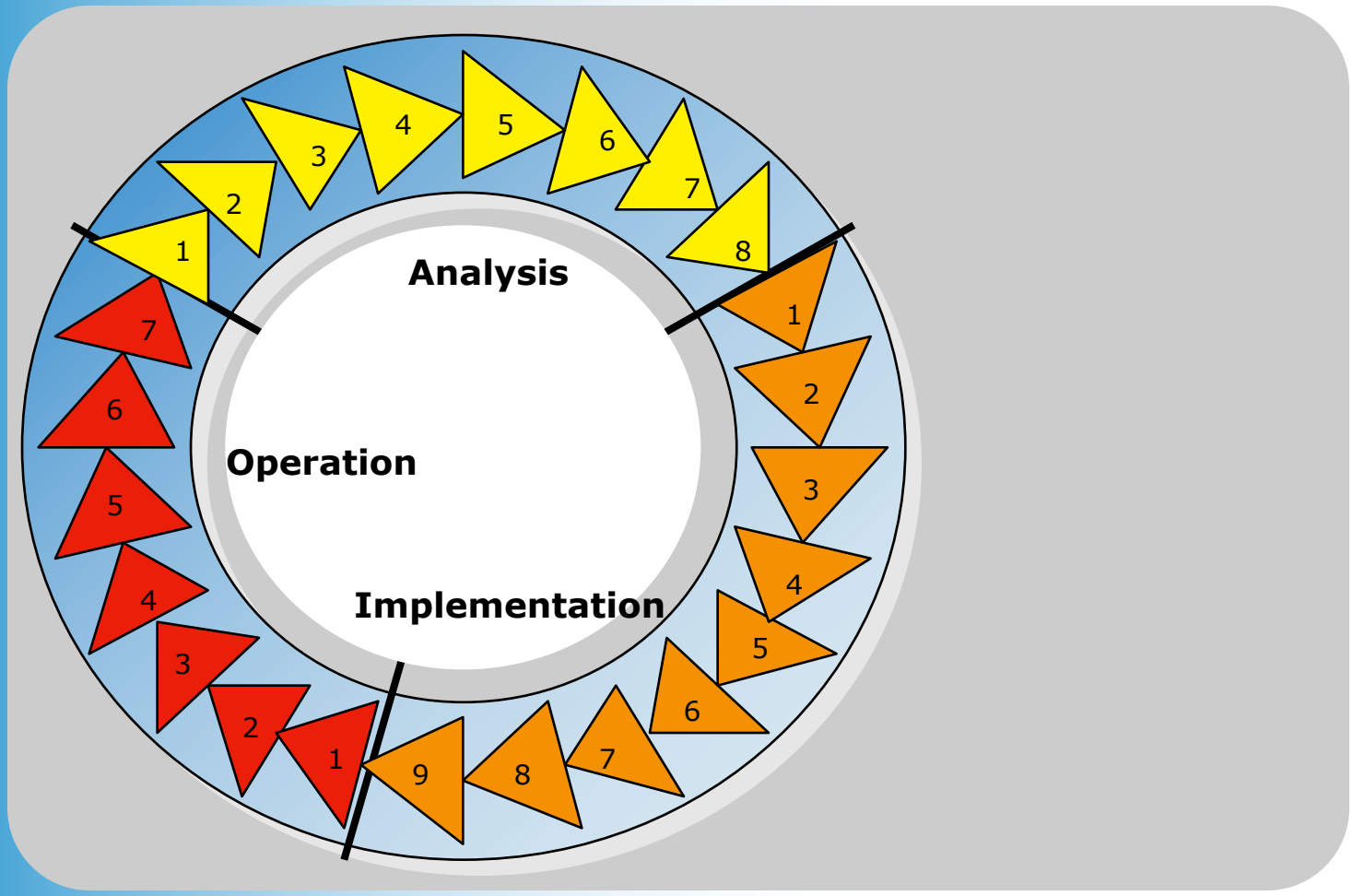

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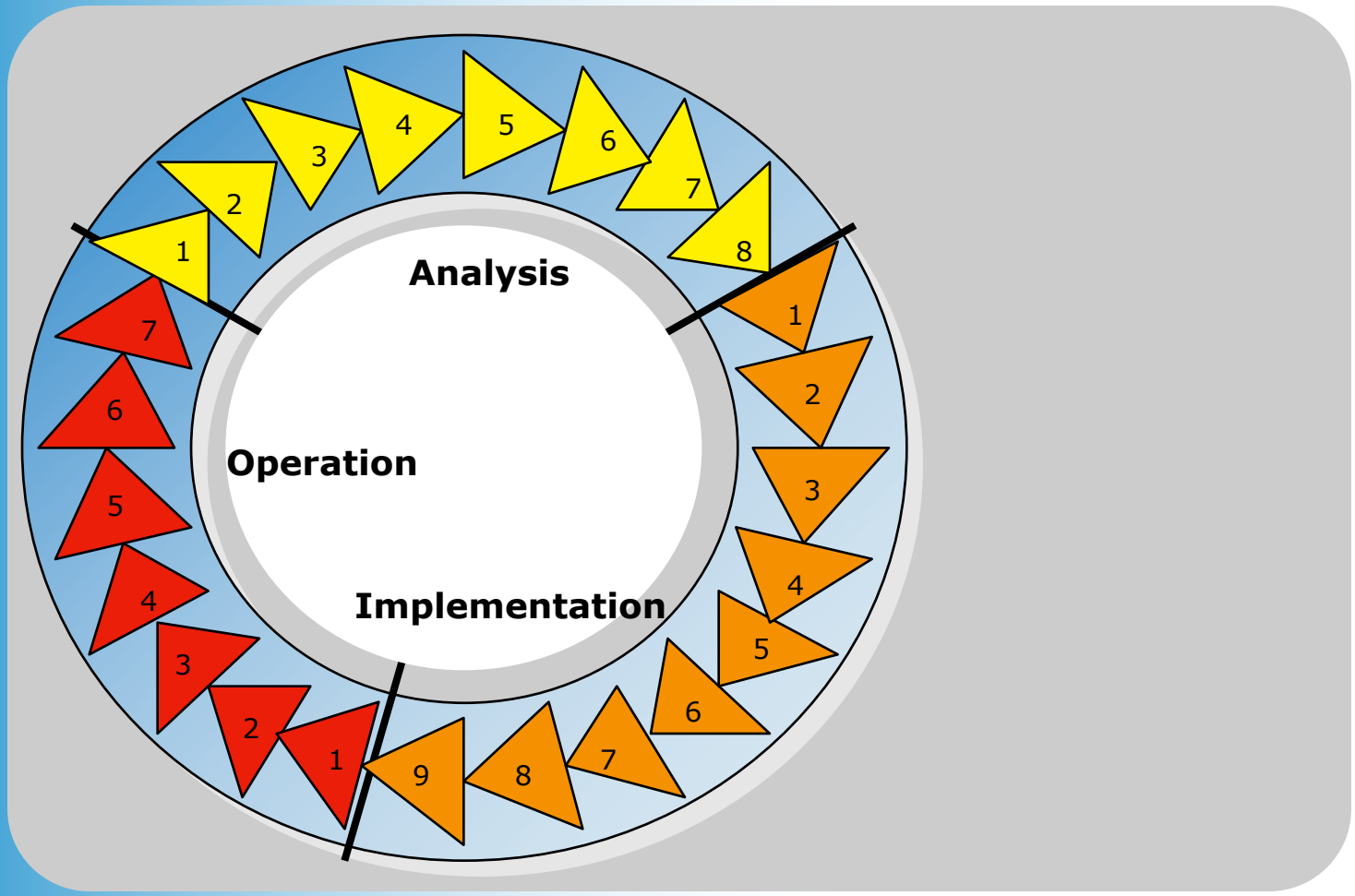

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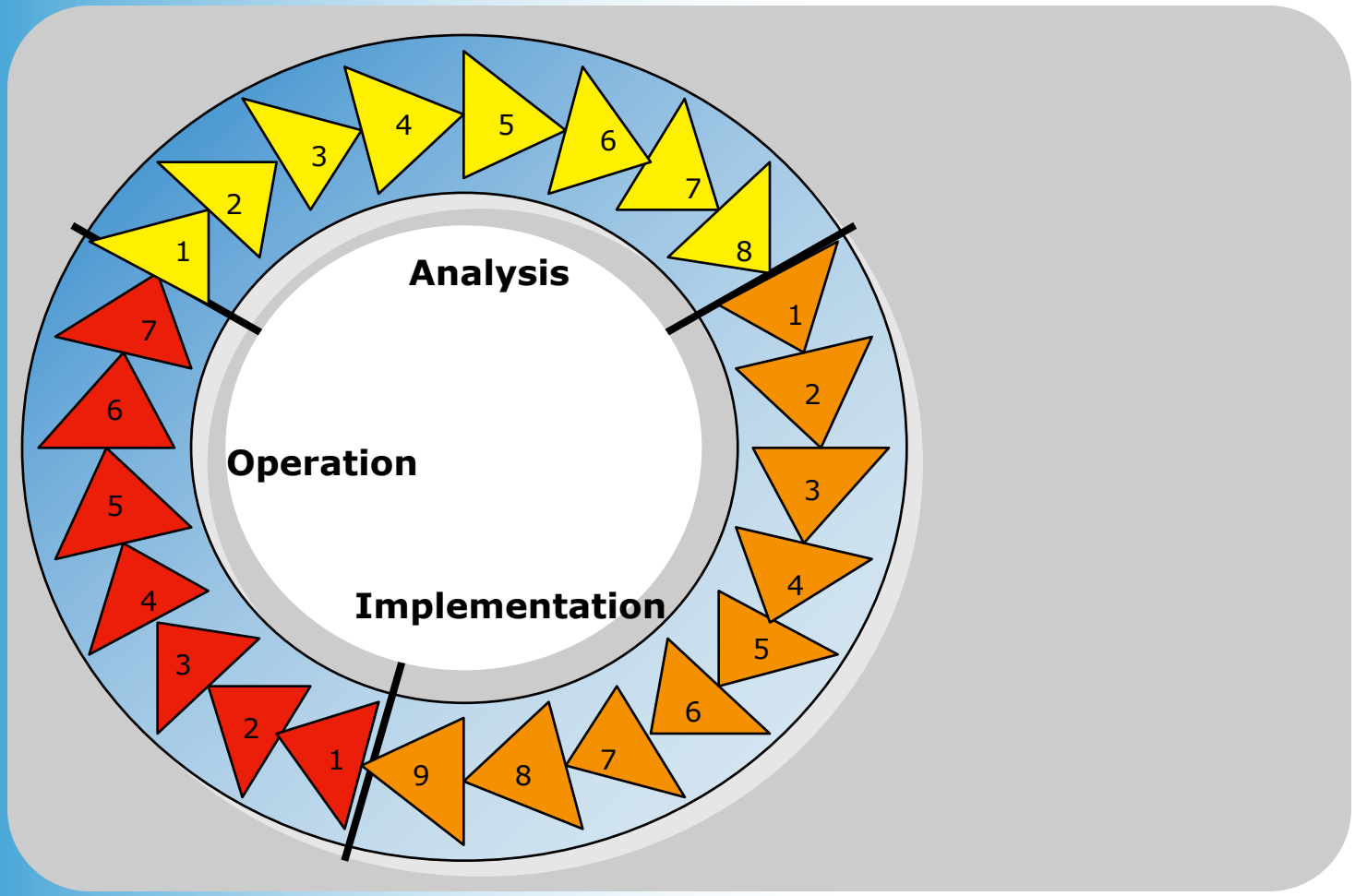

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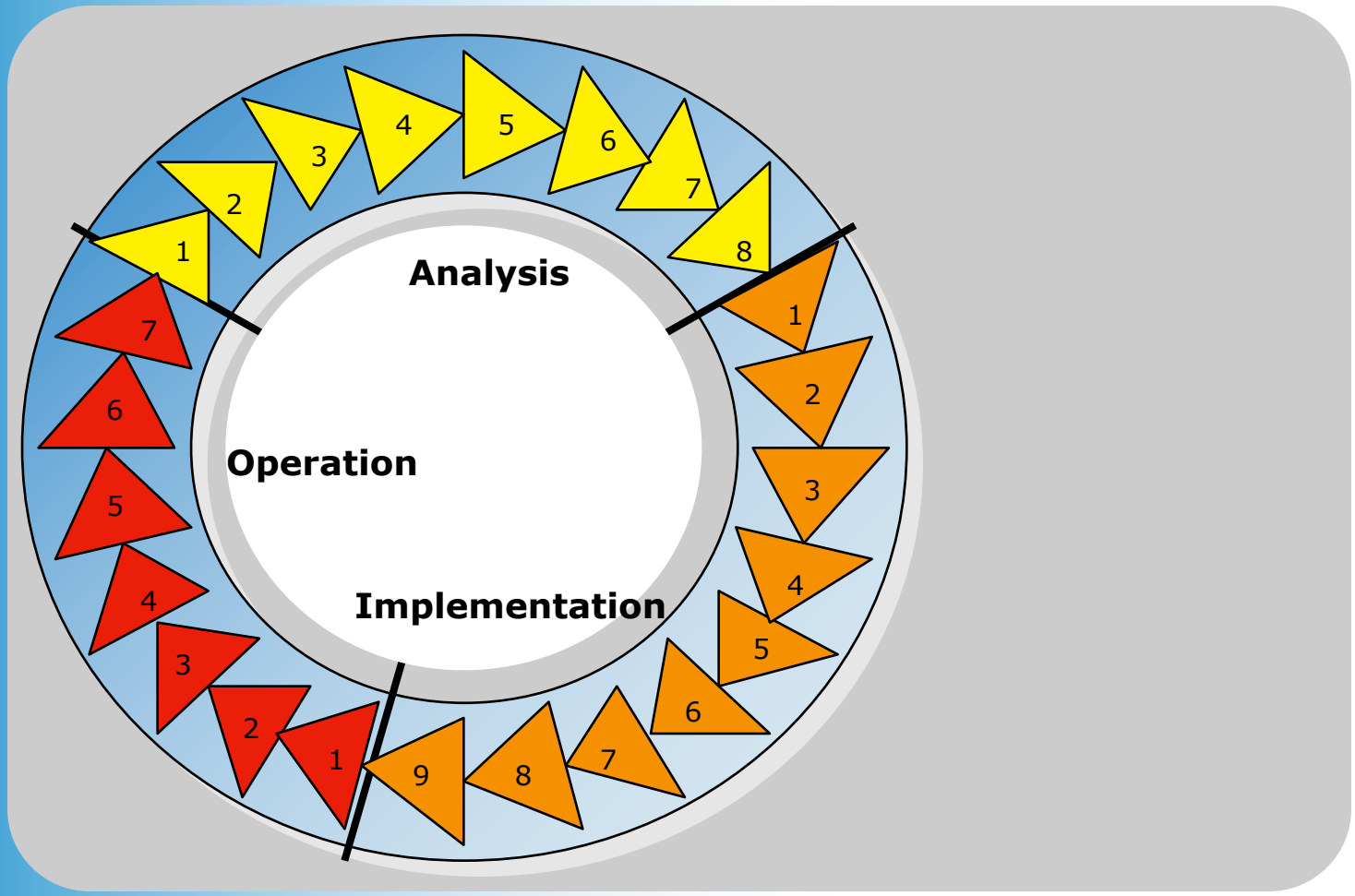
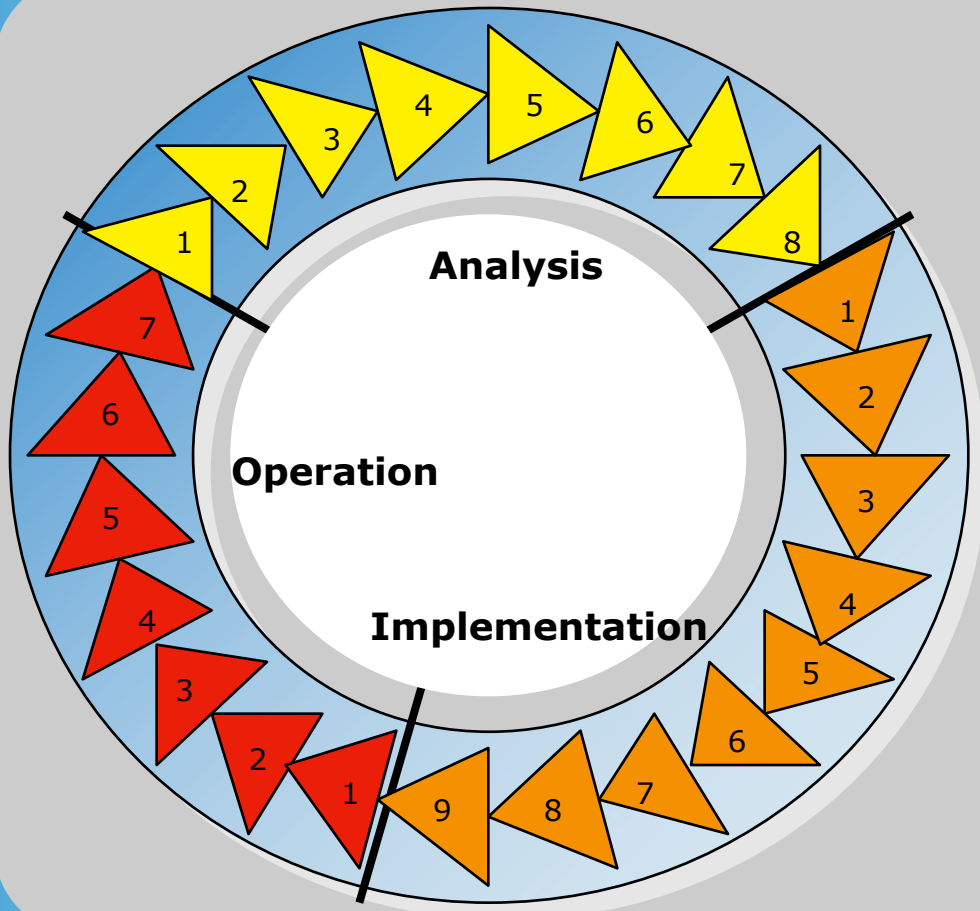


The Analysis Phase



Process Design

- Process Design has the greatest influence on the need for an SIS

- This includes all of the main Process Design Documents
  - *Conceptual Design*
  - *PFDs and Heat/Material Balances*
  - *P&IDs*

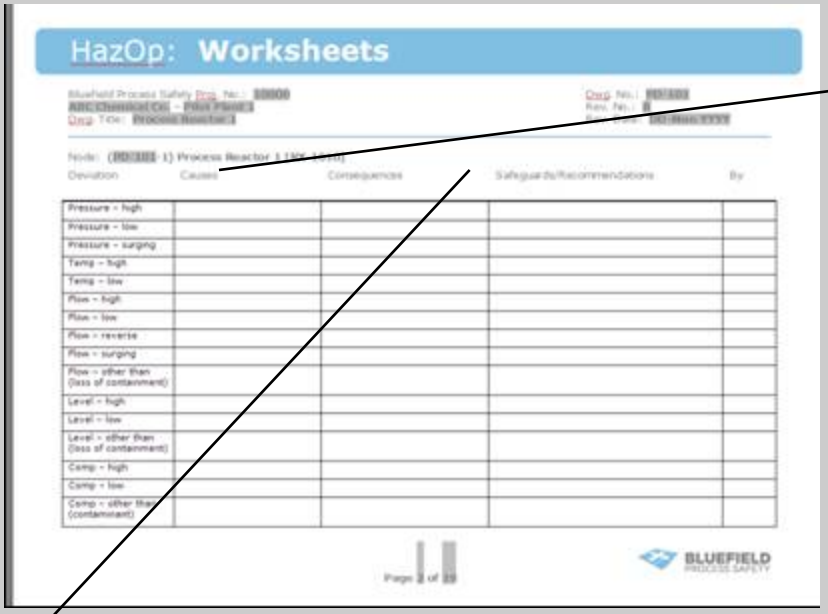
Hazard Identification

- Hazards are identified during the Process Hazard Analysis (PHA)

- Preliminary PHAs
  - *"What If?"*
  - *Checklist*

- Detailed PHA
  - *HazOp (Hazard Operability Review)*

HazOps: Some tips



Tip 1. Take care in identifying the cause. If it's a deviation, that normally means a failure.

Tip 2. Some HazOp methods prompt an identification of frequency. If this is done, do it consistently…with or without safeguards, with or without recommendations, with or without SIFs

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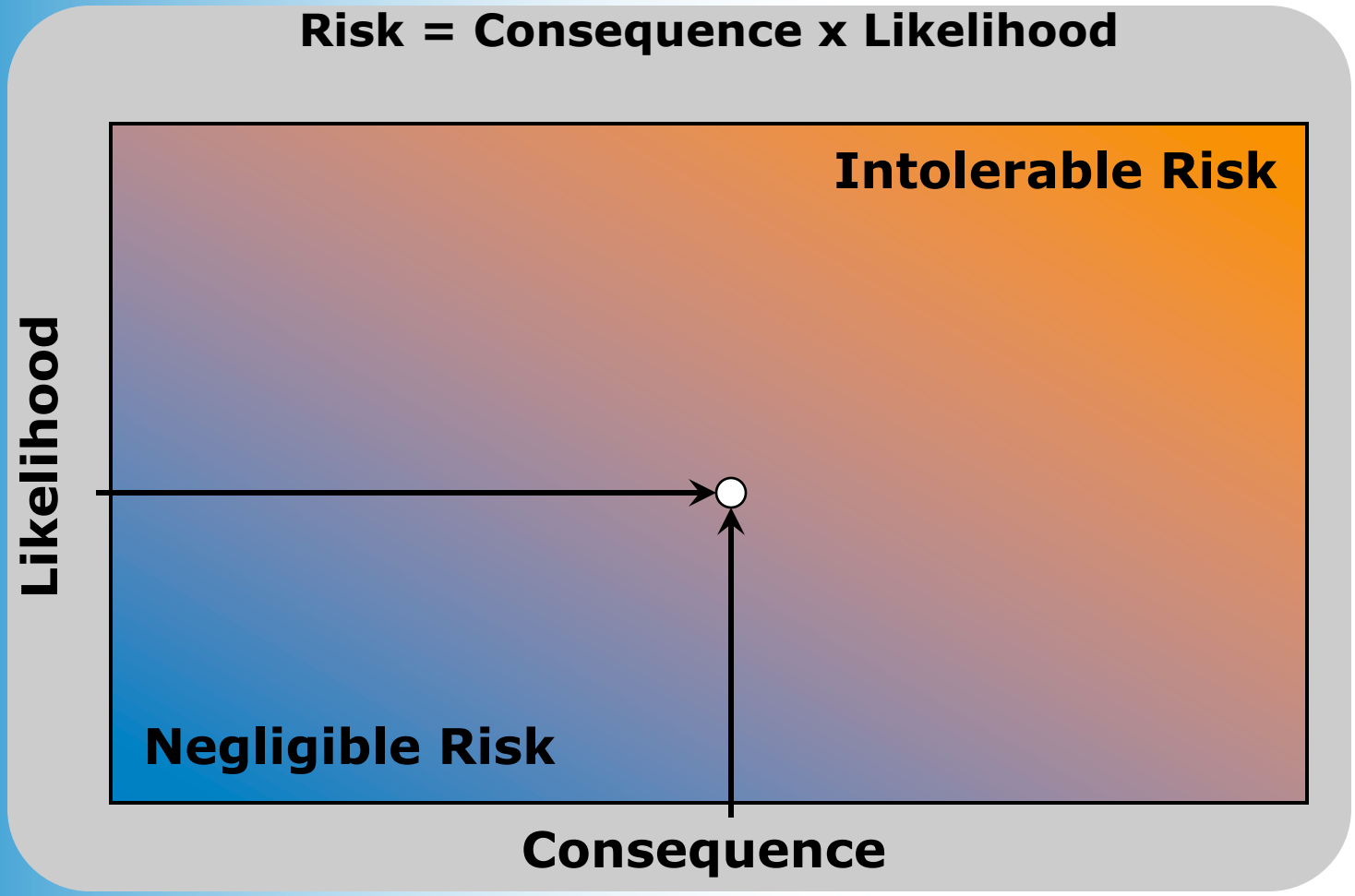
Risk Assessment

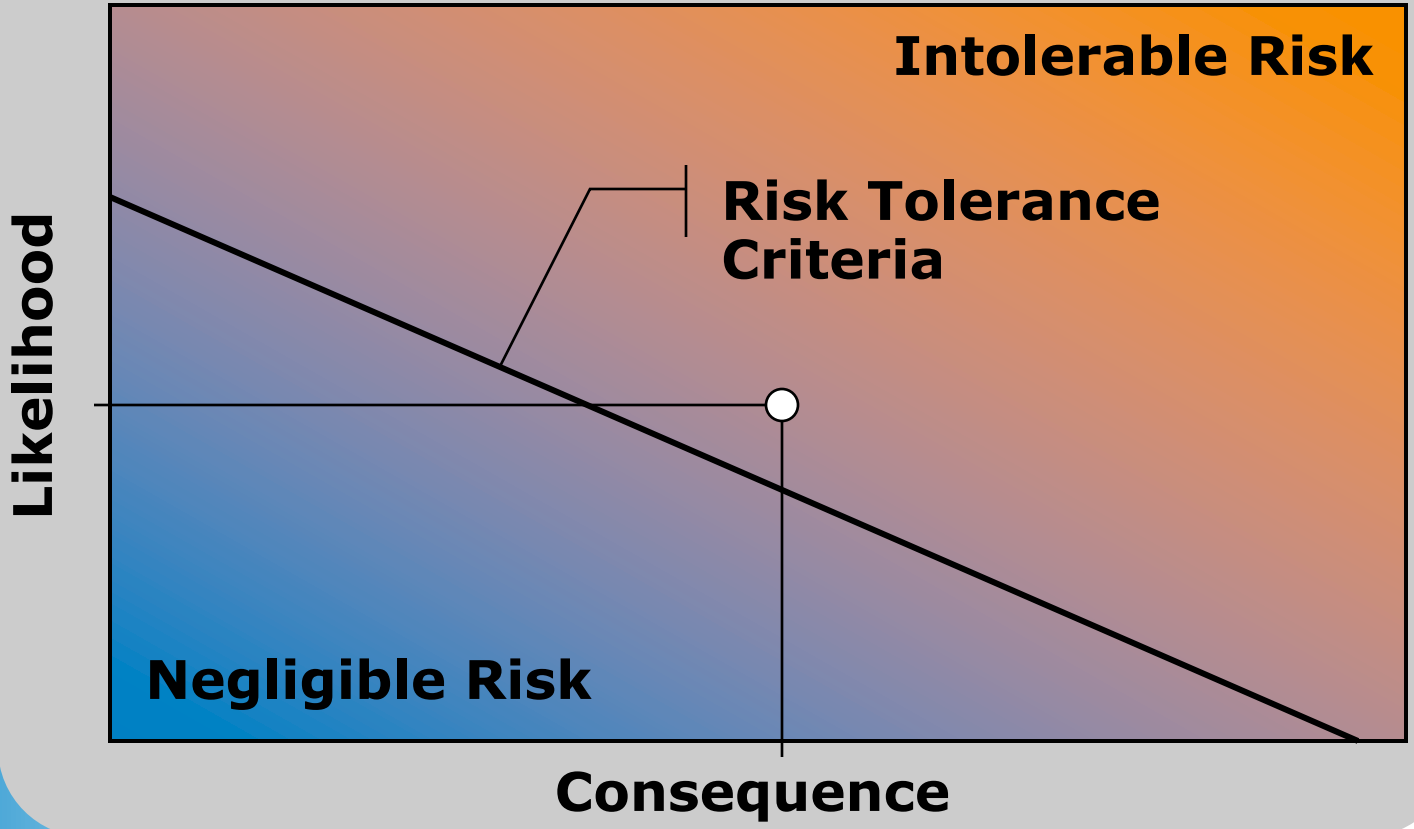


Risk Assessment

- Consequence Analysis
  - *Offsite Consequence Analysis (OCA)*
  - *Quantitative Risk Analysis (QRA)*
- Likelihood Analysis
  - *Layers of Protection Analysis (LOPA)*

How much risk is too much?

Compare: **Risk against Risk Tolerance Criteria**



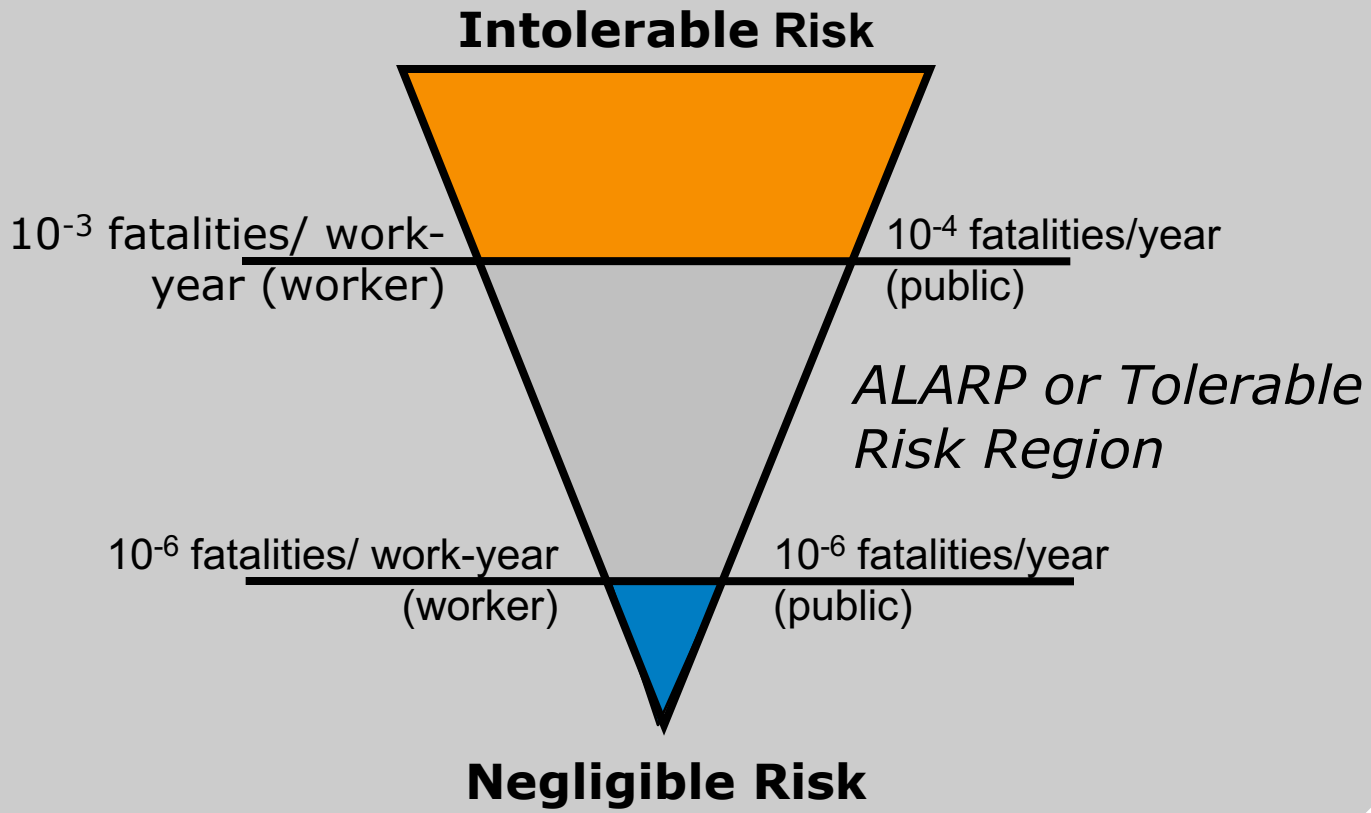
Risk Tolerance Criteria

- May come from any of several sources
  - *Plant policy*
  - *Corporate policy*
  - *Industry benchmarks and guidelines*
  - *Government mandates*

- The United States does not set tolerable risk levels or offer guidelines.

- Outside consultants should not decide for you what is tolerable

ALARP: Levels in the UK



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Factors to Consider

- Number of facilities
- Multi-national or not
- Societal expectations

Large, multinational companies tend to set levels consistent with international mandates, while smaller companies tend to operate in wider ranges and implicitly, at higher levels of risk

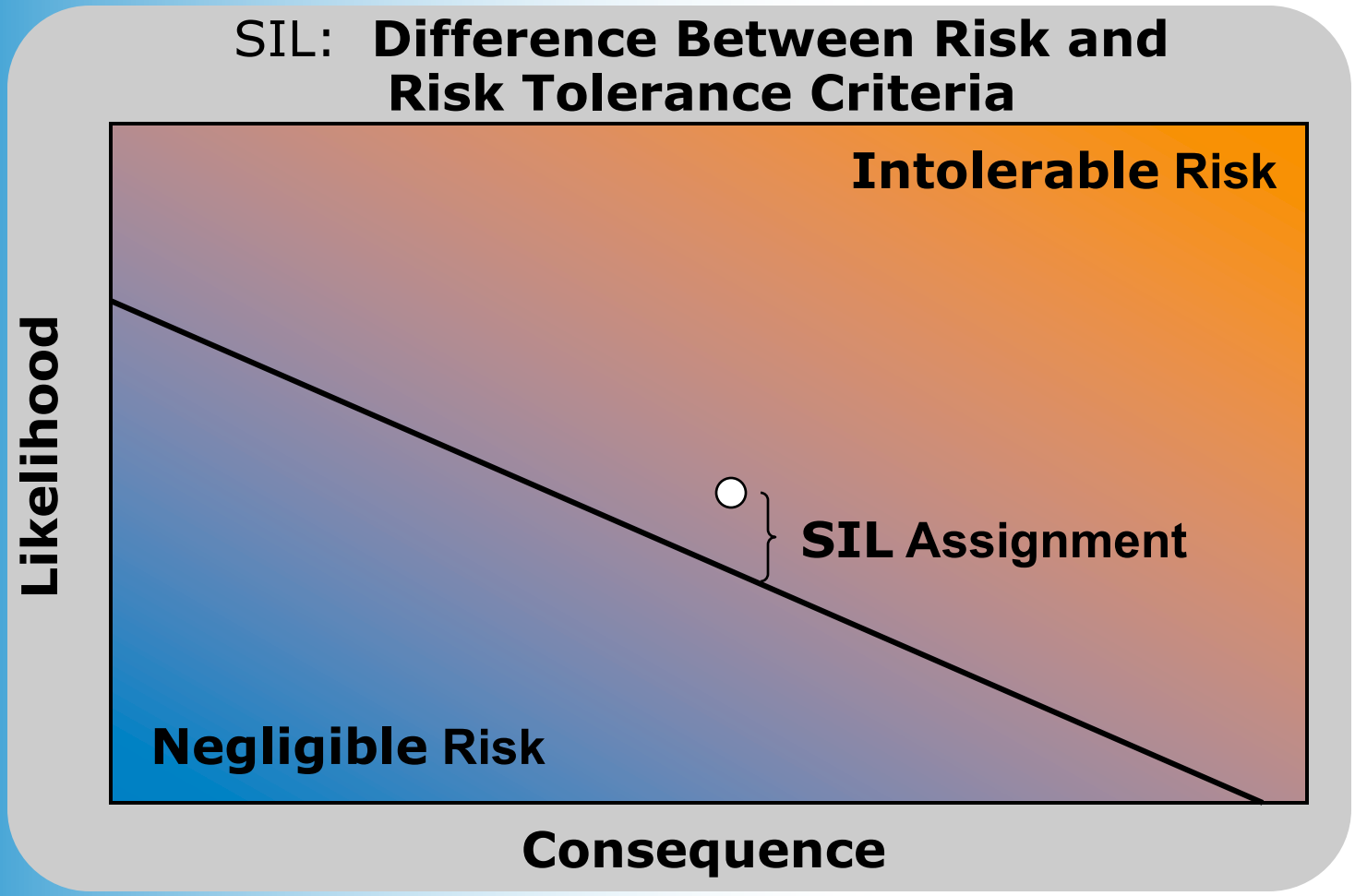
Risk Reduction Allocation

5

When additional risk reduction is required

- Non-instrumented IPLs
  - *Passive components:*
    - Dikes
    - Blast walls
    - Secondary containment
  - *Active components:*
    - Relief devices
    - Redundant equipment or installed spares
- Instrumented IPLs
  - *Control loops within the BPCS*
  - *Safety Instrumented Functions*

How much risk reduction?



Safety Function Definition

- Non-SIS Safety Functions (IPLs):
  - *Scope definition*
  - *Project specification*

  (This follows the normal project cycle)

- SIS:
  - *SIF List*
  - *SIL assignment*

Note: SILs are assigned to functions, not to systems

SIF List

Typically includes

- SIF Tag
- Hazard Description
- SIL Assignment/Required PFDavg
- Trip conditions
  - *Instrument tags*
  - *Set point and direction*
  - *Voting*
- Trip actions
  - *Instrument tags*
  - *Trip state*

Safety Function Specification

- For an SIS, this is the Safety Requirements Specification – the SRS
  - *Used to develop system quotes*
  - *Basis of detailed design*
  - *Basis of configuration*

- More extensive than a SIF List

The SRS – §10.3.1

"These requirements shall be sufficient to design the SIS and shall include the following:"

- A list of 27 bullet items follow
- The SIF List addresses five of them

The SRS – §10.3.1

Other items include

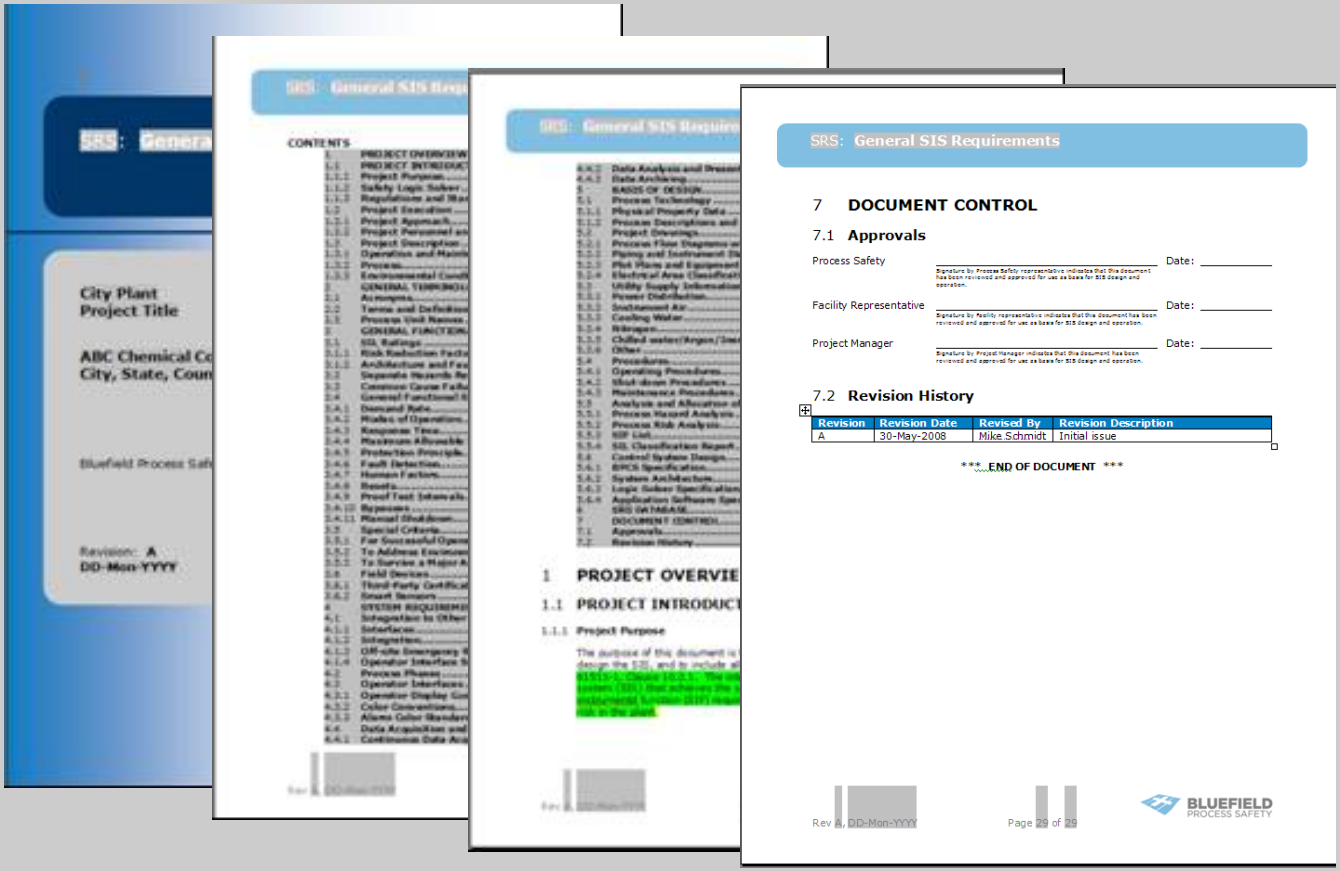
- Source of demand and demand rate
- Proof test intervals
- Response time intervals
- Energize-to-trip or de-energize-to-trip
- Maximum allowable spurious trip rate
- Overrides/inhibits/bypasses
- Resets
- Dangerous combinations

Organizing an SRS

Suggested approach

- General SIS Requirements
- Specific SIF Requirements
- Basis of Design
  - *Policies*
  - *Procedures*
  - *Documents*
  - *Reports*

General SIS Requirements



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Specific SIF Requirements

Datasheet: SIF

Bluefield Process Safety Proj. No.: **1234567** Rev: **A**
ABC Company **Area 1 SIS** Rev. Date: **3/9/2006**
Location: **Anytown, USA** By: **John Doe**

	Target	Achieved
SIL:	1	
PFD:		0.017
MTTFs:		0.2 yr

SIF # 1 P&ID Dwg. No.: **100**

Hazard: **Overflow of Process Tank containing flammable materials resulting in ignition of flammable vapors and flash fire, leading to fatality due to exposure to fire.**

Purpose: **Prevent overflow of Process Tank, 101.**

☑ **Always Enabled**

S	F	
☐	☐	**Stage 1**
☐	☐	**Stage 2**
☐	☐	**Stage 3**
☐	☐	**Stage 4**
☐	☐	**Stage 5**
☐	☐	**Stage 6**
☐	☐	**Stage 7**
☐	☐	**Stage 8**

Action: **On high level, close all inlet valves from feed sources greater than 10% of Process Tank volume.**
(For SIL verification calculations, only one valve is open at a time, even though the SIF doses all valves.)

Function: **1oo1 voting by high level switch. 5 sec delay. First out stays on graphic. Single block valve on each inlet gives 1oo1 voting on final elements.**

On Fault: **For sensor, stop batch and notify operator. For final elements, stop batch and notify operator.**

Notes:

Reset: **Manual**

Bypass: **Device/Forced** Demand: **0.1** **/yr** Trip: **De-energize to trip**

Bypass Clear: **Auto 72hr** Mode: **Low demand** Response: **500** **ms** Rev No.: **A-**

Causes	Set Point		Units	Proof Test	Effects		Safe Action	Group	Proof Test
LSHH--1	Not equal to	On	-	365					
					XV--01	Valve # 1	Closed	1	365
					XV--02	Valve # 2	Closed	1	365
					XV--03	Valve # 3	Closed	5	365
					XV--04	Valve # 4	Closed	5	365
					XV--05	Valve # 5	Closed	5	365
					XV--06	Valve # 6	Closed	5	365

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Reliability Verification

Two kinds of "SIL Calcs"

- SIL Assignment Calculations
  - *Consequence Analysis*
  - *Likelihood Analysis*
- SIL Verification Calculations
  - *Required by standards*
  - *Use a combination of software tools and custom calculations*
    - exida – SILVER (exSILentia)
    - SIS-Tech – SilSOLVER

Before starting SIS design

- Process Design
- Hazard Identification
- Risk Assessment
- Risk Tolerance Criteria Confirmation
- Risk Reduction Allocation
- Safety Function Definition
- Safety Requirements Specification
- Reliability Verification

After the SIS is installed

Are there questions about:

- Witnessing
- Procedures
- Responsibility (Vendor or customer?)
- Certificates
- Frequency
- Training after installation
  (Who needs it? Who can operate?)